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TRANSNATIONAL CORPORATIONS AND TECHNOLOGICAL DEVELOPMENT *

by

Katherin Marton**

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** Consultant, UN Centre on Transnational Corporations, United Nations, New York, 10017, USA.

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1. There is growing awareness in developing countries of the critical role of technology in the process of industrialization. The earlier emphasis on investment flows, usually through TNCs from industrialized economies, is increasingly being replaced by the realization that technology flows and domestic technological development are of equal, if not greater significance. At the same time, it is also being recognised that the present pattern of foreign technology flows and the continued dependence on such flows is not consistent with basic developmental objectives and that an essential policy objective must be to achieve increased technological self-reliance. The concept of technological self-reliance does not deny the importance of foreign technology, rather, it seeks to place it in its proper perspective. Self-reliance thus is conceived in terms of the capacity to identify national technological needs and the selection and application of both foreign and domestic technology under conditions which enhance the growth of national technological capability leading to self-sustained technological development.

2. Planning for technological development cannot be done in a vacuum, but needs to be evolved within the framework of an overall development plan for any economy. A development plan should identify not only broad socio-economic objectives such as increased employment, incomes, regional dispersal and the like, but also determine sectoral priorities and targets sought to be achieved in particular branches of industry within the planning period. Once such development objectives and targets are identified, the determination of technological needs and assessment of alternatives can be undertaken in a proper perspective. Technological progress can undoubtedly take place even without detailed sectoral planning as has occurred in countries such as Korea,

Mexico, and Thailand, but such development tends to be unbalanced and isolated contributing only unevenly to an overall pattern of technological development. If technology planning is to be really effective and comprehensive, it must follow from a broader plan and programme for economic and industrial development.

Objectives of technology policy

3. Rapid growth of technological capability and self-reliance can only be achieved within the framework of a well-defined policy and programme for technological development, oriented to the needs of each economy. Such a policy becomes necessary because the existing pattern of technology use and application have resulted in the perpetuation of dependence on foreign technology and services in most developing countries, except where deliberate policy measures have been adopted in this regard. With increased trade in technology through licencing and management and service contracts, apart from direct foreign investment (DFI), foreign technology and knowhow is emerging as a major factor in industrial relationships between TNCs and developing country enterprises. While developing countries must avail of foreign technology and participate increasingly in international trade in technology, national policies should ensure that such participation is consistent with domestic technological development.

4. Despite the critical importance of this factor, few developing countries have so far adopted a comprehensive plan for technological development. Where technology policies and measures have been undertaken, these have been largely confined to regulating or screening the terms and conditions of

foreign technology acquisition. This by itself would not be enough. Technology policy must cover the selection and choice of technology appropriate to domestic factor resources on the one hand and to national development on the other. It must also ensure the rapid growth of domestic technology and adaptations and innovations are related to local conditions and structures. It should also achieve increased domestic capability in technological services including management, marketing and consultancy engineering know-how. Appropriation of these functions by the domestic economy would impinge directly on the role and activities of TNCs which traditionally have served as a major channel for technology flows to developing countries.

Role and operation of TNCs

5. The importance of TNCs in this context is derived from their capacity to operate in developing countries by combining investment, financial power and management expertise on the one hand and generation or acquisition of technological knowledge on the other. While in several sectors technology ownership is not confined to TNCs and various alternative sources are available, TNCs have been in a position to package various combinations of investment, technology and services in their respective sectors of specialization to a much greater extent than enterprises operating within national boundaries. Thus, increased commercialization of technology and closer technological linkages and interdependence among countries has largely accrued from a process of multinationalization, whereby TNCs have emerged as the principal agents of technology circulation on a global basis. Technological advantage has constituted a major factor in strengthening the competitive position and

and market power of TNCs, which is sustained by a centralized organizational structure, providing the benefits of economies of scale in particular production operations. The global strategy and the international division of labour among the affiliates pursued by the TNC inevitably influence the nature of the transferred technology, the method of transfer, and the terms and conditions attached to the usage of technology by the affiliated enterprises.

6. Historically, commercialization of technology has taken place predominantly within the DFI process of TNCs in host developing countries where they have enjoyed considerable competitive advantage over domestic companies. Estimates of the profitability from foreign operation included not only the returns from the technology itself but revenues from other elements of the DFI package which are tied to the commercialization of the technology. Thus, market entry, particularly through wholly-owned subsidiaries, secured the benefits derived from the whole investment package, such as revenues from equity capital, management services and commercialization of mature technologies which frequently had already been diffused and might even be non-proprietary to the company. DFI consequently enabled also the commercialization of those elements, for example, technology or services which otherwise may have had lower market value.

Pattern of ownership and technology receipts

7. The preference for establishing whole or majority ownership in the host country has been particularly dominant in the case of United States TNCs. Between 1951 - 1974 at the time of entry, over 70 percent of the affiliates established by 180 United States TNCs in developing countries where wholly

or majority owned.[1] This high prevalance of the whole and majority ownership of United States corporations is reflected in the share of technology receipts obtained from their affiliates. In 1977, for example, 79.7 percent of the technology receipts of United States TNCs came from their affiliates. Above-average shares were received from LDCs: 82 from Latin America and 86 percent from Asian and African countries. (This marks a decreasing trend from the previous high of 89 percent and 92 percent, respectively, in 1971).[2]

8. Ownership pattern of non-United States based TNCs shows higher prevalence of minority joint ventures; whole or majority ownership of affiliates established in LDCs until 1970 took place only in the case of 44 percent of the entries.[3] Similarly, in the case of United Kingdom and Federal Republic of Germany TNCs, the receipts from intra-firm technology payments show lower levels than for United States companies. Thus, in 1975 the share of intra-firm technology receipts of United Kingdom TNCs constituted only 30.2 percent of the total receipts.

9. However, for an accurate assessment of the share of intra-firm technology flows, the following limitations of the British data have to be considered:

-- The survey is based on an incomplete response from the 1,200 companies contacted. It is estimated that the returns comprise only 70 percent of the

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1/ See Appendix 1. Ownership pattern of US based affiliates in developing countries, 1951 - 1974.

2/ See Appendix 2, Percentage share of affiliates from the total receipts of fees and royalties of US corporations by geographic areas.

3/ See Appendix 3, Ownership pattern of non-United States based affiliates in developing countries, 1970.

technology receipts; the distribution of the remaining 30 percent is unknown.

— Receipts from oil companies are excluded.

— Technology payments are excluded where charges for technology payments are incorporated in the contract price of capital goods. According to the Board of Trade, this omission is most important in respect to large contracts such as erection of complete plants, where the transfer of technology is an integral part of the contract and receipts from the entire contracts are recorded in the export statistics.

— In the case of companies in the United Kingdom, frequently technology payments of the affiliates are not charged explicitly by the parent company but are part of the total earning of the parent company. This practice has been more prevalent in the case of United Kingdom TNCs than for United States companies.[1/]

10. Because of the definitional differences used in the Federal Republic of Germany, the share of receipts for intra-firm transactions shown by the data is not comparable to the United States or United Kingdom data.[2/] Magnitude of intra-firm transactions is reflected more in the share of intra-firm payments which reached 60.6 percent in 1975.

1/ "Overseas Royalties and Similar Transactions in 1975," Trade and Industry, 12 April 1977, p. 293; and W.B. Reddaway, S.J. Potter and C.T. Taylor, Effects of UK Direct Investment Overseas, Cambridge University Press, 1968.

2/ Technology receipts "do not give a complete picture because not every transfer of technological know-how is connected with corresponding flows of money. In many instances enterprises exchange technological know-how without statistically recordable payments or accounting involved...Sometimes various company members interested in the results share in the research costs. Payments for such future know-how are made as contributions to costs and not as licence payments." "Patents and licence transactions with foreign countries," Monthly Report of the Deutsche Bank, Vol.28, No. 4, April 1976, Frankfurt am Main.

11. Available host country statistics record lower shares of intra-firm technology transactions with all TNCs, indicating that technology contracts with non-United States TNCs take place less frequently within equity-relationship compared with United States TNCs. In 1972, the share of intra-firm technology payments in Argentina was 41 percent; in 1965 in Brazil, it was 58 percent which increased to 72 percent by 1970; and in 1974 in Peru, it was 54 percent. The highest share of intra-firm payments was recorded by Mexico: 78.9 percent in 1971. In 1972 in Thailand, over 60 percent and in 1970 in the Philippines, over 50 percent of the payments were affected between the affiliate and the parent company.[1/]

12. The aggregate share of intra-firm transactions varies not only by home and host countries, but substantial differences exist across industrial sectors. The range of variation is demonstrated, for example in case of Brazil where in a number of sectors - automobile, transformers, tobacco, electric motors - close to 100 percent of the technology payments were affected between the affiliate and the parent company.[2/] In the more "traditional" sectors, such as wood, paper, leather where technologies are more widely diffused or available from the manufacturer of the machinery, technology payments between independent domestic companies and TNCs predominate.

13. While the analysis of the sectoral distribution of the share of intra-firm technology payments is hindered by the paucity of information published by LDCs, the degree of foreign ownership within a given sector indicates the importance

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1/ D. Chudnovsky, et. al., Aspectos económicos de la importación de tecnología en la Argentina en 1972, INTI, Buenos Aires, 1974; A.F. Biato, E.A.A. Guimaraes and M.H. Poppe de Figueredo, A Transferencia de Tecnologia no Brasil, IPEA, Brasilia, 1973; ITINTEC, Efecto del proceso de importación de tecnología en el Perú, 1971-1974, Lima, 1976; F. Fajnzylber and M. Tarrago, Las empresas transnacionales, CIDE/CONACYT, Mexico, 1975; UNIDO, Development and Transfer of Technology Series, No.1, New York, 1977.

2/ Appendix 6, "Share of intra-firm technology payments in electrical industries," Brazil, 1965-1970.

of transfer of technology through TNC equity participation. Analysis of the share of foreign penetration in the different sectors of the manufacturing industry in several developing countries shows that foreign ownership and thus transfer of technology by equity participation has been predominant in the research-intensive, oligopolistic sectors such as pharmaceuticals, petrochemicals, electronics and transportation equipment.[1/] At the same time, the data shows that within these industries substantial country-by-country variations exist, which reflect the different host government regulation towards DFI and its foreign technology acquisition policy, and the capability of the domestic economy to absorb foreign technology without foreign participation. Furthermore, differences are also attributable to the different attractiveness of a given home country for the TNCs and thus its willingness to commercialize technology depackaged from DFI.

Emerging trends

14. While the TNCs' preference for establishing wholly-owned subsidiaries and tight control over the technology within the corporate system is generally recognized, their willingness to engage in joint ventures and sale or licensing of technology without equity involvement has become increasingly prevalent in a large number of sectors. Regulatory measures of developing countries to limit the foreign share of equity has been possible in sectors where alternative sources of technology are available which strengthened the bargaining position of the host country. In other instances, the domestic economy's technological capability was strong enough to absorb the foreign technology within the contract period. The scope of acquisition of technology through licensing and service agreements at an

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1/ See Appendix 7.

enterprise-to-enterprise level becomes greater with increasing entrepreneurial and technological capacity in a host country. Thus, licensing without foreign equity participation requires an adequate technological base on the part of the domestic recipient enterprise which enables adequate absorption of foreign technology. Similarly, in sectors where a slow pace of technological change allowed the standardization and diffusion of technology, alternative contractual arrangements to foreign equity participation becomes increasingly possible. Consequently, there is a growing trend towards non-equity or minority foreign ownership arrangements in several countries where the domestic entrepreneurial and technological infra-structure in particular sectors have developed adequately.

15. The market power of TNCs, however, continues to be a dominant factor in determining the availability and pattern of technology transfer in advanced science-based sectors where technology ownership is largely concentrated in a few large TNCs. In these sectors, due to increasing R and D costs, the economies of scale involved in technological innovation and commercialization and high costs of market failure, large companies have become the major source of technological development and consequently, owners of improved and new technology. Similarly, in sectors where fast technological change reduces the product life cycle, for example, in the case of drugs, scientific instruments and electronics, significance of technological advantage in the competitive position of the firm renders retention of control over the technology within the corporate system the major motivating factor in the commercialization of technology. In these sectors, transfer of technological know-how remains confined largely to wholly or majority-owned subsidiaries. Where

foreign minority ownership is unavoidable, effective control over technology use is sought to be achieved through management or service contracts. Diffusion of technology in these advanced sectors and entry by competitive firms is limited frequently on the one hand, by a large degree of cross-licensing, patent pooling and other forms of technology sharing arrangements among the leading TNCs and by intra-firm technology flow on the other hand. These barriers to entry resulting from the concentration of technology ownership among the industry leaders have been particularly prevalent, for example in the chemical industry and in the manufacturing of heavy electrical and telecommunication equipment. In these sectors, the fact of effective control over proprietary technology by a limited number of TNCs and their oligopolistic power enables to subject the form of entry and conditions of transfer to the global strategy of TNC.

16. Despite the regulatory measures instituted by several LDCs and the increased availability of technological alternatives in certain sectors, the role of TNC subsidiaries and affiliates in most developing countries assume special significance because of their dominant position in several branches of industry for historical reasons.[1/] In most countries of Africa and Latin America, mineral industries remained largely under foreign ownership or control even though greater domestic participation, often through state

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1/ Share of foreign ownership in LDCs in the manufacturing industry and in selected sectors are shown in Appendix 7.

enterprises, has been increasing in recent years. State participation and control have been most marked in the petroleum industry, but both in petroleum and other resource-based industries, TNCs have continued to exercise significant control through supply of technology and services. In several developing countries, even relatively low-technology, consumer goods production has remained under the control of foreign subsidiaries. In the case of middle-technology and high-technology industrial sectors, TNC subsidiaries and affiliates exert dominant influence even in countries, for example, Brazil, India, Korea where significant domestic entrepreneurial capability is available. In several service sectors, including merchandising, TNC subsidiaries and affiliates continue to play a decisive role in many developing countries. In the formulation of national technological policy in these countries, it is essential therefore to ensure that the technological impact of TNC operations, both in respect of existing subsidiaries and affiliates and future arrangments with TNCs, are evaluated and taken into account.

Impact on technological development

17. The role of TNCs in terms of their impact on domestic technological development and capability in various branches of manufacturing and services is being seriously questioned in several countries. The concept of international division of labour and consequential uneven development of technological capability is itself inconsistent with national development objectives and priorities of many LDC countries. With growing policy emphasis on key areas such as greater downstream processing in resource-based industries, production of basic industrial materials and machinery and equipment, establishment of linkage and feeder industries in various sectors, increased domestic

integration and value-added as against assembly operations, the technological needs of most developing countries would be substantially different from the existing pattern of technology flows through TNCs. The selection of products and the manufacture of differentiated goods by TNCs, supported by trademarks and brand names, are often viewed as having an adverse socio-cultural impact including the creation of consumer needs which emulate consumption patterns in developed countries and are geared to the needs of higher income consumer segments in these countries. There is also greater awareness that the type of technology imported by TNCs is often not suitable for developing countries, as these tend to replicate the operations of parent TNCs and reflect the needs, market conditions and techno-economic endowments of industrialized economies. When applied in certain developing countries, they may necessitate the maintenance of a high input proportion or high degrees of absorptive and operational skills which requires a long learning period. Similarly, the appropriateness of highly capital-intensive technology in sectors where available technological alternatives would be more consistent with factor endowments and development objectives are increasingly questioned. The fact that R and D activities in the case of TNCs are almost wholly conducted in developed countries is also increasingly being recognised as severely restricting the growth of innovative and adaptive capability in developing countries.[1/] The high costs of foreign technology and the restrictive and limiting conditions under which they are made available to developing country enterprises, including TNC subsidiaries

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1/ R and D expenditures of United States TNCs spent abroad are given in Appendix 11.

and affiliates is also an issue receiving increasing attention in several developing countries.

Patenting strategy

18. An important aspect of TNCs control over diffusion of technology stems from their patenting strategy which secures proprietary rights on a world-wide basis. While the extent of patenting by major TNCs has been declining in certain sectors, for example in pharmaceuticals, where a high rate of competitive imitation limits willingness to patents. Patenting acts in many sectors as a significant hindering element in technology diffusion process in developing countries.

19. Under the present international patent system, adopted by the majority of LDCs, the foreign patent holder is granted the same legal protection as the domestic innovator. In addition, patenting confers the TNCs the exclusive right to export if the market size does not justify local production. This protection awarded to the patent holder resulted in excessively high levels of patent registration in LDCs with actual utilization rates often falling below 1 percent of the registered patents. In Colombia, for example, from the 3,513 patents registered in the late 1960s in the chemical industry, only ten were used in industrial production.[1/] Similarly, in 1975 in Peru, the patent utilization rate was below .5.[2/]

1/ C.V. Vaitsos, "Patents Revisited: Their Function in Developing Countries," Journal of Development Studies. Vol. 9, No. 1, October 1972.

2/ M.A. Cevallos y Muniz, Análisis estadístico de las patentes en el Perú, Consejo Nacional de Investigación, Lima, 1976.

20. The extensive patenting activity of TNCs has had a strong supressing effect on local innovative activity and contributed to a continuous decline in the share of locally owned patents. This trend is demonstrated in the example of Chile, shown in Appendix 8, which was characteristic for most developing countries throughout the past decades. The insignificantly low share and economic importance of locally held patents tend to demonstrate that the present patent system has hampered the development of local innovative activity. Recent patent legislations adopted by some developing countries have aimed to reduce the negative impact of the patenting strategy of TNCs. The new patent law of Mexico (1976) aims to reduce the time span of patent validity and thus increase the diffusion of the technology within the economy. Simarly, the Brazilian patent law which prohibits the patentability in sectors which are deemed to be vital for national development such as food processing, aims to limit the monopoly power based on the ownership of proprietary technology in certain sectors. Increase in market competitivenes is envisaged by the new Mexican law which imposes compulsory licensing requirement in case of non-utilization of the patent within two years of its registration.

TNCs and domestic R and D

21. As proprietary and non-proprietary knowledge is transferred by a TNC partly in embodied and disembodied form from the parent company, there is little interest or initiative for R and D activities by subsidiaries and affiliates. Since affiliates obtain only those elements which have already been commercialized in the home market, the R and D function has been completed for the specific technology at the parent company. New technologies, including improvements, are developed in the parent company, which is close to the

initial commercialization of the technology and has an advanced scientific and technological infrastructure. Centralization of technology generation at the parent company also helps to ensure the control over proprietary technology. Local R and D activity in developing countries is confined to local product adaptation testing of products which are not available in developed countries, such as certain drugs, or in case of products which are only locally produced such as tea processing.[1/] The absence of R and D in the host country renders the affiliate dependent on the parent company for the continuous flow of technological improvements which becomes a major element of control. Technology ownership can be similarly the controlling element in the case of joint ventures, particularly when technology transfer includes patented know-how brands or trademark names.

22. The lack of R and D activity by TNC affiliates has significant repercussions on the development of national scientific and technological capacity in the host country. The low demand for scientific and research personnel hinders the development of indigenous engineering and design capabilities necessary for the effective absorption of foreign technology and indigeneous technology creation. Also in the absence of local R and D, the affiliate has little technological linkage with local scientific and research institutions, which would promote technological research capability and promote diffusion within the economy.

1/ OECD, Development Centre Studies, "Transfer of Technology by Multinational Corporations", Vol. 1 (ed.), D. Germidis, Paris, 1977; C. de Faro Passos, "Multinational corporations and transfer of technology: The case of Brazil" and R. Kaplinsky and S. Chishti, "Multinational corporations and transfer of technology: Some British multinationsl in Kenya and India", in OECD Development Centre Studies, ibid.

23. The increased alternatives open for domestic companies to acquire foreign technology through licensing can have far-reaching implications on domestic R and D activities in various production and service sectors. Given the initial low national scientific and technological capacity of most developing countries, the large and long-term commitments needed in R and D activity and the risks involved in innovation, the acquisition of foreign technology with a predictable performance has more economic justification for domestic companies than technology generation by internal R and D. Furthermore, marketing risks can be substantially reduced if the domestic company acquires rights to use foreign brand names and trademarks which enjoy high market acceptance. Usually, foreign trademark and brand usage requires the application of foreign technology, quality control and technical assistance which reduces the need for R and D to be performed by the domestic licencee. Consequently, in developing countries where private corporations have the freedom to select suppliers for their technological needs, there is a general preference towards acquiring foreign technology even though similar alternatives might be available from local companies. This bias towards foreign technology acquisition by domestic companies can only be counterbalanced by the pursuit of a conscious government technology policy aiming at greater utilization of domestic technology, where these are competitive or more appropriate in the context of overall development objectives.

Cost of foreign technology

24. Cost of foreign technology for developing countries are difficult to estimate on an aggregate level. Technology payments as indicated in the balance of payments of selected LDCs are shown in Appendix 10. This comprises, however, only the

direct costs accruing from royalty and fee payments which might be only a small part of the associated indirect costs resulting from the restrictions imposed on the foreign technology users. Furthermore, in many developing countries, transfer of technology takes place predominantly by intra-firm technology transactions where the parent company might not charge a separate price for the wholly-owned affiliate, or might charge lower price than in case of a joint venture when revenues from technology are included in the total return of the company. Similarly, initial engineering and design costs which are not of a recurring nature are not included in the technology payment balance but may constitute part of the trade balance.

25. Several studies have sought to compare the costs of foreign technology according to the method of acquisition, usually contrasting acquisition with TNC equity ownership and licensing by independent domestic companies.[1/] Because of the different nature of the DFI and the technology package, however, neither costs nor benefits are directly comparable. Also evaluation of the two alternatives seldom arises as the technology acquisition in form of TNC equity participation is generally based on a decision when technology decomposed from the DFI package is not available for the host country or when the locally available skill levels are not sufficient to absorb the foreign technology without a long-term commitment on the part of the foreign technology seller.

1/ For example, a recent study was prepared by D. Chudnovsky, 'Pricing of intra-firm technological transactions,' for a conference on transfer pricing at the Institute of Development Studies, University of Sussex, March 1978.

26. It is increasingly being recognized that DFI may be a relatively costly method to obtain foreign financial capital. At the same time, financial investment may serve as a vehicle to obtain technical management or marketing know-how or access to export markets, which may not be accessible without equity ownership.[1/] If access to certain essential technology is only feasible as part of an investment package, the foreign affiliate may be tied to the parent company in a number of ways which gives rise to different financial flows which may be difficult to determine in precise terms. The parent company is interested in the total returns from the affiliate, and the breakdown of the payments will be determined from financial management considerations and home and host country regulations (e.g. tax laws, foreign exchange regulation, maximum royalties, etc.). Consequently, payments accruing to equity generally contain substantial parts which reflect returns to these other inputs as well as the oligopoly situation they create.

27. Indirect costs of foreign technology arise from the restrictions imposed by the TNC on the user of the licensed technology. Restrictions aim to retain control over the operations of the licensee and thus increase the return from the commercialization of the technology. This takes place partly by tying management and supply requirements, such as intermediate and capital goods which effectively limit the depackaging of the technology by the user and renders monopolistic benefits by way of overpricing the tied inputs. Similarly,

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1/ C. Vaitsos, Money as a negotiable input in international business activities, paper presented at the United Nations Centre on Transnational Corporations Round Table on Negotiations with Transnational Corporations, Seven Springs, April 1978.

export restrictions imposed on the technology user aim to protect the other markets of the TNC's global operation from possible competition from the licensee. The prevalence of restrictive clauses, which today are well documented for technology contracts entered into during the 1950s and 1960s, have shown that overpricing of tied inputs, management contracts, and production and export restrictions might be a multiple of direct costs.[1/]

28. It is against the above background of TNC operations in technology transfer that certain policy trends in host developing countries should be considered. The present trend is to move away from wholly-owned foreign subsidiaries, and the screening of foreign investment proposals in most developing countries aimes at greater domestic participation in ownership and control. Foreign subsidiaries are still encouraged or accepted in situations where alternative sources of capital investment may not be available as in the case of mineral and resource based industries in some countries, or in ~~high~~ technology sectors where technology would not otherwise be available, for example, in electronics or drugs and pharmaceuticals or in primarily export-oriented enterprises. In most other fields, the policy trend is to encourage joint ventures, with different degrees of foreign participation, including gradual divestment of foreign holdings within a certain time frame. The well-defined policy towards DFI has an important bearing on the technological development of a particular sector and the policy instruments that have to be utilized to ensure greater domestic technological growth.

1/ A recent comprehensive review of the literature on transfer pricing practices of transnational corporations is presented in the UNCTAD Study, Dominant Positions of Market Power of Transnational Corporations: Use of the Transfer Pricing Mechanisms, (UNCTAD/ST/MD/6), July 1977.

Technology policy has to be framed so as to deal with various situations of foreign ownership and control, and must be viewed as an integral part of an overall policy towards direct foreign investment and the role ascribed to DFI in various sectors of the economy.

Technology policy and TNCs

29. In view of the dominant and continuing role of TNCs as one of the major channels for technology transfer to developing countries, technology planning and policies must be directly related to the operation of TNCs and their impact in the host country. The nature of technology flow and its repercussions on the technological capability of developing countries, as discussed above, emphasise the need for an overall reappraisal and review of the technology acquisition process through TNCs, and the role of specific country institutions, as an essential aspect of technology planning.

30. There can be little doubt that a very substantial increase in the flow of technology to developing countries must take place if an adequate pace of industrial growth is to be achieved. Since in a large number of manufacturing and service sectors TNCs retain oligopolistic control over technology, a considerable proportion of technology acquisition may need to take place through their operation. In view, however, of the characteristic of technology strategy implemented by TNCs host country, technology plans and policies will need to channel the operation of TNCs according to national objectives and priorities.

31. It has been mentioned earlier that identification of technological needs in terms of developmental and sectoral priorities constitutes an initial aspect of technology planning. Once such needs are assessed from a long-term

perspective and in terms of short-period development plans, the specific role and the possible pattern of corporate relationships with TNCs in various sectors of the economy can be established. In certain branches, particularly high-technology industries, it may be necessary to utilize TNCs, both as sources of investment and as suppliers of proprietory technology. In sectors where the domestic industry has the necessary entrepreneurial capability and technological base, technological needs may be served by licensing and other contractual arrangements without foreign capital participation. In certain fields, it may not be desirable to encourage foreign technology flows in order to utilize and enhance domestic innovative capability. This approach would be relevant in sectors where appropriate domestic technology is available or where foreign technology has been adequately absorbed by domestic industrial enterprises.

32. Within the context of sectoral technological needs, the choice of technology becomes an essential consideration. As discussed earlier, technology available from TNCs is generally firm-specific or specific in terms of particular differentiated goods produced by a parent TNC or its affiliates. Thus, in the selection and evaluation of products and technology adequate knowledge of alternatives is a major precondition. The need for a technological information system in developing countries reflects the significance of information on technological alternatives. Knowledge of alternatives and the capability to evaluate and compare alternatives may be critical for determing the 'appropriateness' and suitability of particular technologies in different country situations.

33. The role and functions to be exercised by institutional agencies constitute an important aspect of technology planning. The scope of their operation can be extended to various levels of intervention, ranging from screening of the technology for its suitability and necessity for the domestic economy including the terms and conditions of technology utilization. In most cases, institutions dealing with information on technological alternatives may provide useful assistance in evaluation process with the ultimate choice being exercised by the enterprise concerned. The selection and evaluation of alternatives can have considerable impact on the nature of technology acquired from TNCs and the modifications and adjustments that may need to be made before these are applied.

34. The technological requirements of linkage industries also constitute an important element of negotiations with TNCs. In the case of mineral industries, for example, technology for downstream processing stages would be a significant aspect to be considered and host country and TNC interests would need to be harmonized. Similarly, the extent and nature of domestic integration and the increase in value-added over a defined period need to be established in the course of negotiations. The development of domestic marketing and managerial expertise, besides operational skills, should also be identified as being an important responsibility of TNCs in various sectors.

35. An important aspect of negotiations with TNCs relates to the disaggregation or unbundling of the technology package. TNCs tend to aggregate the investment function with the various technology elements including project engineering, production technology, management and marketing. From the host

developing country's viewpoint, it is important that the package should be unbundled and evaluated in terms of its various components. The unbundling of the technology package is important for determining the cost element of each part in the package, but of even greater significance is the possibility of domestic industry to participate in the supply of inputs and project engineering services. Even if the cost of domestic goods and services tends to be above world market prices in earlier stages of industrialization, this may nevertheless be justified in the long-term interests of development of domestic capabilities. The extent of unbundling may, however, be limited in certain sectors where TNCs can ensure that the technology is used only by a subsidiary or affiliate under its control or is sold only in the form of a complete system, and not as separate components. Similarly, where foreign engineering contractors with the skills to combine various inputs are themselves dependent on the technology supplier, the incentive to "unbundle" may be weak or lacking. In such cases, a great deal may depend on the technical and managerial expertise and contracting skills available in the host country. Some countries have, accordingly, placed great emphasis on the development of domestic capabilities in consultant services.

36. The terms and conditions of technology contracts with TNCs have received considerable attention in many developing countries. Legislative measures have been introduced in some countries against the imposition of restrictive business practices, including 'tie-in' provisions for supply of imported parts, and various restrictions concerning production and sales territory. The period of agreement is also sought to be limited as well as the continued use of the

technology after the contract period ensured. Regulatory institutions in several countries have adopted guidelines which are fairly similar in scope. At the international level, a Code of Conduct in respect of technology transfer is under inter-governmental negotiations in UNCTAD.

37. The response of TNCs to technology regulation has tended to vary from country to country, depending primarily on the bargaining capacity of the country emanating largely from the market size and endowments. Thus, in Brazil and Mexico, regulation does not seem to have resulted in any significant reduction of technology flow through TNCs. In countries with smaller domestic markets, the impact of regulation may well be different and policy guidelines have to take this factor into account.

38. It is important that the impact of operations of TNC subsidiaries and affiliates on domestic technological development is monitored on a continuous basis. This review process follows the path of technological development the R and D undertaken by the foreign affiliate and the adaptations performed to suit local conditions and requirements. This review should cover existing subsidiaries and affiliates and also new enterprises involving TNC's participation.

39. Given the realities that foreign technology will continue to flow to developing countries through the channel of TNCs, subject to their global interests and operations in various sectors, it is necessary for host countries to establish comprehensive policy measures, supported by institutional mechanisms, which enhances the development of technological capacity. Policy measures should cover the overall policy in respect of DFI including sectors reserved for State

enterprises and wholly national-owned enterprises, and policies in respect of foreign capital ownership in different sectors. The exercise of selectivity in this regard through a process of regulation and screening would have a direct bearing on technology flows through TNCs and should result in a greater flow of technology and know-how through other arrangements such as licensing and service contracts. The regulation and screening of technology and service contracts should be a logical follow-up of regulation of DFI. This should included the identification of sectors and branches in which foreign technology should not be encouraged or where it should only be permitted to the extent that it supplements domestic technological capability. Measures for 'unbundling' of technology should enable maximum use of domestic inputs, particularly technological services, including project engineering, management and marketing know-how. Policy guidelines can also be prescribed concerning restrictions in use of foreign personnel, training programmes for domestic personnel at various levels, and enterprise-level of R and D. Import restrictions and controls can significantly affect greater technology flow for linkage industries and adaptive use of local materials and parts. Export incentives and insistence on export commitments by TNC subsidiaries can, on the other hand, improve the balance of payments performance of TNCs and achieve better quality production. Implementation of a comprehensive policy system can be a major contributing factor in programming for domestic technological development.

40. It is equally important that institutional facilities are established and developed to bring about greater domestic capability in various sectors. Governmental agencies to screen foreign investment and foreign technology

proposals already exist in several countries. Their role and functions in respect of domestic technological development may, however, need to be more comprehensively defined. At the same time, institutional assistance to domestic industry is necessary in respect of technological information, including on alternatives and on different forms and conditions of technology of service contracts. Similar institutional guidance and support is essential for assessing the impact of foreign technology in various sectors and in linkage industries. Domestic R and D institutions dealing with industrial technology have also to establish closer links with industrial enterprises, including TNC subsidiaries and affiliates. One of the basic functions of such institutions should also be to provide the institutional framework within which negotiations with TNCs are conducted and projects with TNC involvement are implemented. A comprehensive programme for domestic technological development must extend considerably beyond the harmonization of host country policies and objectives to that of TNC subsidiaries and affiliates. At the same time, such harmonization must be viewed as an essential feature of technology planning designed to achieve greater domestic technology capability in developing countries.

Appendix I

Ownership pattern at time of entry of affiliates in developing countries of 180 United States-based transnational corporations, 1951-1975

Year	Wholly owned (95 - 100 per cent)	Majority-owned (51 - 94 per cent)	Co-owned (50 per cent)	Minority-owned (10 - 49 per cent)	Unknown	Total number
			(Percentage)			
1951-1966	60.4	12.9	6.6	12.3	7.8	2 364
1967-69	65.7	13.2	7.6	10.4	3.1	850
1970-72	68.5	12.0	6.8	12.0	0.7	724
1973-75	63.8	9.8	2.9	19.4	4.1	614

Source: Joan Curhan, William Davidson, Rajan Suri, Tracing the Multinationals, Ballinger Publishing Co., Cambridge, Mass. 1977.

Appendix 2

Percentage share of affiliates from the total receipts of fees and royalties a/ of United States corporations, by geographical area, 1965-1977

Year	Total	European Economic Community (6)	Japan	Latin American republics and other Western hemisphere	Other countries in Asia and Africa b/
1965	n.a.	n.a.	24.5	n.a.	n.a.
1971	78.1	76.7	31.4	88.2	92.0
1977	79.7	80.1	50.9	81.8	85.8

Source: United States Department of Commerce, Survey of Current Business, various issues.

a/ Includes film rentals. Methodology is explained in Survey of Current Business, December 1973, p. 15.

b/ Includes all countries of Asia except Australia and New Zealand and all of Africa except South Africa.

Appendix

Ownership pattern of manufacturing subsidiaries of 211 non-United States transnational corporations in developing countries, 1970

Type of ownership	Number of subsidiaries	Percentage share from total number of subsidiaries
Total number of subsidiaries of which:	1,895	100.0
Wholly-owned a/	392	20.7
Majority-owned	428	22.6
Co-owned	298	15.7
Minority-owned	441	23.3
Unknown	336	17.7

Source: Computation based on Transnational Corporations in World Development: A Re-examination, United Nations, 1978, Table C.13.

a/ Subsidiaries of which the parent firm of the system owns 95 per cent or more are classified as wholly-owned; over 50 per cent, as majority-owned; exactly 50 per cent as co-owned; 5 to less than 50 per cent as minority-owned.

Appendix 4

Estimated[a] overseas royalties and fees,[b] United Kingdom, 1965-1975

(Millions of pounds sterling)

	1965	1970	1975
Total receipts	64.8	142.1	274.4
Total payments	55.7	118.1	238.3
Balance	+9.1	+24.0	+ 36.1
Percentage share of receipts with affiliates	33.6	31.2	31.6
Percentage share of payments with affiliates	53.1	57.1	63.3

Source: Trade and Industry, 12 August 1977, p. 293.

*For the method of estimation, see page 3.

**All industries, including film, excluding oil companies.

Appendix 5

Royalties and fees of the Federal Republic of Germany, 1971, 1975
(Millions of US dollars)

	Affiliate firms				Unaffiliate firms		Total	
	1971		1975		1971	1975	1971	1975
	Value	Percentage of total	Value	Percentage of total				
Receipts	7.2	4.6	16.7	5.2	129.2	291.4	156.4	323.5
Payments	-209.1	49.2	-562.1	67.4	-90.5	-166.6	-424.8	834.0
Balance . .	-201.9		-545.4		+38.7	+124.8	-268.4	-510.5

Source: Monthly Report of the Deutsche Bundesbank, 1973, 1976

Appendix 6

Share of intra-firm technology payments in selected industries, Brazil, 1965-1970

Industrial sector	Percentage share of intra-firm payments from total technology payments
Glass	57
Cement	52
Non-metallic products	54
Metalworking machinery	93
Textile machinery	83
Electrical motors	97
Transformers	100
Household electrical products	82
Transportation equipment	100
Wood	-
Furniture	-
Paper	45
Rubber	100
Leather and furs	94
Inorganic chemicals (including fertilizers)	65

Source: F. Alveida Biato, E.A.A. Guimaraes and M.H. Peppe de Figueiredo, A Transferencia de Tecnologia no Brasil, IPEA, Brasilia, 1973.

Appendix T.1

Estimated shares of manufacturing held by foreign enterprises, selected countries and territories, latest available year

Country or territory	Percentage foreign share of:				Year	Criterion of foreign ownership (Percentage)
	Sales	Employment	Assets	Value added		
Nigeria	...	...	70 c/	...	1968	...
Canada	56	52	...	...	1975	50 and more
Malaysia	...	...	50 b/	...	1971	...
Ghana	50 c/	...	...	...	1974	...
Brazil	49 d/	...	29 a/	37 e/	1974	...
Peru	46	...	...	...	1969	...
Australia	36	29	42	34	1972/73	25 and more
Turkey	...	...	41	...	1974	10 and more
South Africa	...	...	40 c/	...	1972	...
Belgium	33	18	...	...	1968	...
New Zealand	33	...	...	...	1969/70	...
Central American Common Market	31	...	...	...	1971	...
Argentina	31	...	...	...	1972	...
Singapore	...	30	...	...	1968	...
Mexico	27	...	...	23	1972	...
France	27	19	...	...	1973	20 and more
Germany, Federal Republic of	25	22	...	23	1972	...
Austria	23	25	20	...	1973	50 and more
Norway	19	12	11	18	1974	...
United Kingdom	14	10	16	13	1971	...
India	13	...	...	...	1973	50 and more
Denmark	11 f/	...	...	...	1971	...
Korea, Republic of	11	...	...	...	1974	...
Spain	11	...	...	...	1971	50 and more
Hong Kong	...	11	...	...	1971	...
Sweden	10	...	8	...	1974	20 and more
Thailand	...	9	...	...	1970	...
Finland	5	4	...	...	1972	20 and more
Japan	4	2	...	...	1972	20 and more
United States	4	3	...	...	1974	10 and more

(Source and foot-notes on following page)

Source: United Nations Centre on Transnational Corporations, based on: United Nations, Department of Economic and Social Affairs, Yearbook of Industrial Statistics, 1975 (United Nations publication, Sales No. E.77.XXVII.7); Organisation for Economic Co-operation and Development, Pénétration des entreprises multinationales dans l'industrie manufacturière des pays membres (Paris, 1977); International Labour Organisation, The Impact of Transnational Enterprises on Employment in the Developing Countries, prepared by Y. Sabolo and R. Trajtenberg (Geneva, 1976); Business International, Investing, Licensing and Training Conditions Abroad (New York, various issues); Nigeria, Federal Office of Statistics, Industrial Survey of Nigeria, 1968 (Lagos, 1971); Statistics Canada, Canada's International Investment Position, 1971-1973 (Ottawa, 1977); "Quem é quem na economia brasileira", Visao, 31 August 1975; R. Newfarmer and W. Mueller, Multinational Corporations in Brazil and Mexico: Structural Sources of Economic and Non-economic Power (Washington, D.C., Government Printing Office, 1975); Instituto de Planificacion Nacional, Algunos aspectos de la articulación, concentración, y dependencia estructural en la industria manufacturera peruana (Lima, 1975); Australian Bureau of Statistics, Foreign Control in Manufacturing Industry, 1972-1973 (Canberra, 1976); T. G. Vras, "Research on foreign capital investment in Turkey" in Turkey, an Economic Survey, 1977 (Istanbul, Turkish Industrialists' and Business Association, 1977); New Zealand Department of Statistics, Supplement to March 1974 Monthly Abstract of Statistics (Wellington, 1976); "Algunos apuntes sobre el grado de participación de la inversión extranjera directa en el proceso de la integración centroamericana" in E. Lizano, ed. La integracion economica centroamericana, (Mexico, Fondo de Cultura Economica, 1975); International Labour Organisation, El impacto de las empresas transnacionales sobre el empleo y los ingresos: el caso de Argentina, prepared by J. Sourrouille (Geneva, 1976); Osterreichische Nationalbank, Ausländische Direktinvestitionen in Osterreich (Vienna, 1976); Republic of Korea, Economic Planning Board, Special Survey on Operations of Foreign Private Firms in Korea, 1974 (Seoul, 1976); United States Department of Commerce, Foreign Investment in the United States (Washington, D.C., 1976).

a/ Based on the 625 largest manufacturing enterprises.

b/ Based on all commercial enterprises. Foreign share of assets based on all limited companies was 62 per cent in 1971.

c/ Based on total industry.

d/ Based on the 1,000 largest enterprises.

e/ Based on the 5,113 largest non-financial enterprises.

f/ Excluding car assembly and oil refining.

Appendix 7.2

Estimated foreign-controlled shares of the pharmaceutical industry; selected countries, 1975 a/

(Percentage)

Country and country group	Share of sales (Percentage)
Saudi Arabia	100
Nigeria	97
Belgium	90
Colombia	90
Venezuela	88
Brazil	85
Canada	85
Australia	85
Indonesia	85
Mexico	82
Central American Common Market (1970)	80
India	75
Iran	75
Argentina	70
United Kingdom	60
Italy	60
South Africa	60
Finland (1971)	50
Sweden	50
France	45
Portugal (1970)	44 b/
Turkey (1974)	40
Norway (1971)	36
Germany, Federal Republic of	35
Switzerland (1971)	34
Greece	28
Egypt (1971)	19
United States	15
Japan	13

Source: United Nations Centre on Transnational Corporations, based on United Nations Conference on Trade and Development, Major Issues Arising from the Transfer of Technology to Developing Countries (United Nations publication, Sales No.E.75.II.D.2); Business International, Investing, Licensing and Trading Conditions Abroad (New York, 1976); S. Lall, "The International Pharmaceutical Industry in Less Developed Countries, with Special Reference to India", Oxford Bulletin of Economics and Statistics, August 1974, p.162; Business Latin America, various issues; L.M. Wortzel, "Technology transfer in the pharmaceutical industry" (New York, UNITAR, 1971); "The Mathi Committee on the Indian Drug industry", in Report of the Committee on Drugs and Pharmaceutical Industry (New Delhi, Ministry of Petroleum and Chemicals, 1975); A. Cilingiroglu, "Transfer of Technology for Pharmaceutical Chemicals" (Paris, Organization for Economic Co-operation and Development, 1974); J. Katz, Oligopoli, firmas nacionales y empresas multinacionales (Buenos Aires, Siglo Veintiuno, 1974); M. Mandousson, The Pharmaceutical Industry in Egypt, Ph.D. Thesis, University of London, 1974; United States Department of Commerce, Foreign Direct Investment in the United States (Washington, D.C., 1976); Japan Ministry of Foreign Trade and Industry, Trends in Foreign Capital Enterprises (Tokyo, 1971); L. Schaumann, Pharmaceutical Industry Dynamics and Outlook to 1985 (Menlo Park, Stanford Research Institute, 1976), table 3.

a/ Except where otherwise indicated.

b/ Refers to the market share held by the 15 largest foreign-owned companies out of the total 64 foreign-owned companies.

Appendix 7.3

Estimated foreign-controlled shares of selected industries in Brazil, Turkey and India, 1974

(Percentage)

Industry	Shares of: Assets		Output
	Brazil a/	Turkey	India b/
Manufacturing (total)	29	41	13
of which:			
Textiles	...	74	...
Food	31	58	...
Tobacco	99		...
Paper	...	56	...
Chemicals	...	...	33
Rubber	61	59	52
Electrical machinery	61	54	...
Non-electrical machinery	...	43	25
Transport equipment	68	...	10
Motor vehicles		38	
Ferrous and non-ferrous products	...	...	41
Metal goods	...	23	...
Non-metallic products	35	...	...
Mining	12	...	8

Source: "Quem é quem na economía brasileira", Visao, August 1975; T. G. Uras, "Research on foreign capital investment in Turkey", in Turkey, An Economic Survey, 1977, (Istanbul, Turkish Industrialists and Business Association, 1977); Reserve Bank of India, Bulletin, July 1975.

a/ Based on 5,113 non-financial enterprises.

b/ Data for 1973.

Appendix 7.4

. Indicators of foreign participation in selected industries in developed market economies and developing countries, selected years.

	Estimated percentage of foreign share of:						
	Chemicals	Rubber	Iron and steel basic industry	Non-electrical machinery	Electrical machinery	Motor vehicles	Year
ISIC No.	(351-352)	(355)	(371)	(382)	(383)	(3843)	
Argentina	37(0)	75(0)	...	82(0)	33(0)	84(0)	1969
Brazil	51(0)	44(0)	61(0) b/	55(A) b/	33(A) b/	100(A)	1976
India	27(0)	52(0)	41(0)	25(0)	33(0)	10(0)	1973
Korea, Republic of . . .	22(E)	...	37(0)	19(0)	...	...	1970
Mexico	67(0)	94(0)	37(0)	31(0)	63(0)	...	1973
Peru	67(S)	88(S)	...	25(S)	62(S)	...	1969
Philippines	...	73(0)	...	...	...	43(A)	1973
Singapore	46(E)	76(E)	21(E)	...	...	...	1969

(Source and foot-notes on following page)

Source; United Nations Centre on Transnational Corporations, Transnational Corporations in World Development: A Reexamination, New York, 1978.

Appendix 7.5

Estimated foreign-controlled shares of selected Mexican industries, 1962-1970

(Percentage)

Industry	Estimated share of sales accounted for by foreign-controlled enterprises		Increase in share between 1962 and 1970 (Percentage points)
	1962	1970	
Manufacturing (total)	20	28	8
of which:			
Tobacco	65	80	15
Paper	22	27	5
Rubber	77	84	7
Chemicals	58	67	9
Non-metallic mineral products	24	27	3
Primary metals	18	25	7
Fabricated metals	21	37	16
Non-electrical machinery	45	62	17
Electrical machinery	58	79	21
Transportation equipment	43	49	6

Source: United Nations Centre on Transnational Corporations, based on R. Newfarmer and W. Mueller, Multinational Corporations in Brazil and Mexico: Structural Sources of Economic and Noneconomic Power (Washington, D.C., Government Printing Office, 1975).

Appendix 7.6

Estimated foreign-controlled shares of output and employment in manufacturing, Argentina, 1955-1972

Year	Estimated percentage of output	Estimated percentage of employment
1955	18	11
1960	21	12
1965	26	11
1970	27	11
1972	31	11

Source: United Nations Centre on Transnational Corporations, based on Banco Central and Censo Industrial of Argentina in International Labour Organisation, El impacto de las empresas transnacionales sobre el empleo y los ingresos: el caso de Argentina, prepared by J. Sourrouille (Geneva, 1976).

Appendix 8

Share of patents registered by foreigners, Chile

Year	Percentage of patents registered by foreigners
1937	65.5
1947	80.0
1958	89.0
1967	94.5
1976	90.0

Source: C.V. Vaitsos, "Patents Revisisted: Their Function in Developing Countries", Journal of Development Studies, Vol. 9, No. 1, October 1972, WIPO, Industrial Property, Geneva, 1977.

Appendix 9

Share of patents registered by non-residents in selected developing countries, 19

Country	1965	1970	1976
Argentina	n.a.	77.7	69.2
Bolivia	n.a.	89.5	86.7
Chile	91.5	93.8	89.5
Colombia	93.4	80.8	78.6
Ecuador	n.a.	96.3	86.7
Ghana	100.0	100.0	100.0
Hong Kong	n.a.	98.6	98.8
India	90.2	83.1	82.6
Iran	93.1	92.7	96.8
Kenya	100.0	100.0	100.0
Korea, Republic of	38.7	25.1	32.5
Morocco	93.5	94.5	93.5
Philippines	96.0	96.5	87.6
Tanzania, United Republic of	100.0	100.0	100.0
Tunisia	95.6	99.3	91.6[a/]
Venezuela	94.5	92.0	84.5[a/]
Zaire	100.0	100.0	92.5
Zambia	n.a.	99.4	98.0[a/]

Source: Based on WIPO, Industrial Property, Geneva, 1977.

a/ 1975.

Appendix 10

Receipts and payments of royalties and fees of selected developing countries
(Millions of dollars)

	1971			1976		
	Receipts	Payments	Balance	Receipts	Payments	Balance
Argentina (1970, 1975)	19	76	-57	34	78	-44
a) management fees and salaries	10	6	+4	16	11	+5
b) royalties	9	70	-61	18	67	-49
Colombia (1970, 1975)	3	10	-7	2	5	-3
Costa Rica (1970, 1975)	—	2	-2	—	3	-3
Ecuador (1970, 1975)	—	—	—	—	27	-27
El Salvador (1970, 1975)	—	2	-2	00	1	-1
Israel	22	28	-6	17	43	-26
Jamaica	—	2	-2	—	5	-5
Korea	22	30	-8	106	65	41
Trinidad and Tobago	—	5	-5	—	8	-8
India (1971-72, 1975-76)	—	26	-26	—	43	-43

Source: International Monetary Fund, Balance of Payments Yearbook, Vol. 28; for India: Indian Investment Centre, Economic News Digest, August 1978.

Appendix II

Country distribution of estimated total of R and D abroad by United States-based companies

(Percentage)

Country	1966	1975
Canada	22.2	13.1
United Kingdom	24.4	18.8
Common Market	38.9	50.6
Federal Republic of Germany	22.3	29.9
France	9.1	8.1
Belgium	3.2	3.5
Italy	2.6	6.1
Netherlands	1.7	3.0
Switzerland	1.1	2.0
Japan	0.6	0.7
Australia and New Zealand	4.1	3.7
Argentina	1.1	0.6
Brazil	0.7	2.9
Rest of the World	6.9	7.6
Total amount (in millions of dollars)	537	1 331

Source: D. Creamer, "Foreign Research and Development by U.S. Multinational Corporations", Conference Board, New York, 1977.

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TECHNOLOGICAL DEVELOPMENT PROCESS AND SELF-RELIANCE IN LATIN AMERICA *

by

C. A. Martínez Vidal **

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** Chief, Technological Development Unit, Organization of American States
19th Street and Constitution Avenue, NW Washington DC 20006, USA

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I. Introduction

1. This presentation was requested by UNIDO as a working paper to be presented before the Special Group on Technological Development and Self-reliance in Developing Countries. Thus, it is not an analytical academic discussion, but a brief presentation of the author's notes and personal experiences on the subject. It does not pretend to be original or exhaustive, it does not contain bibliographical notes, and its scope is limited to Latin America. In view of the limited time available for its preparation, this presentation constitutes only a draft of the final paper.

2. Technological development and self-reliance has long been posed in Latin America as the problematic of science-technology-development-dependency, with its intra- and extra-relationships. During the last ten years, Latin America, through hundreds of studies and articles, has proved to be able to assess serious and rigorously its own reality, to elaborate original theoretical analyses of that reality, and to define feasible policies and strategies.

3. Implementation of a self-reliance technological policy implies a real political determination of the countries and their government that goes far beyond its simple enunciation --which in many cases is just a rhetorical statement of policies. Unfortunately, this second stage of implementing already formulated policies has been, with some exceptions, deficient and limited, in spite of a permanent effort to

relate thought and action. And one of the main causes of this problem has been the lack of institutional continuity and the political instability, characteristic of our continent. Such is the case of some decisions of the Cartagena Agreement, the statements of CACTAL, the laws regulating the transfer of technology in Argentina and Mexico, the Brazilian industrial property law, etc. The relatively few studies devoted to the implementation of technical change in those same countries, as compared to the large number of studies covering the first stage, clearly confirm this fact.

II. Latin American Development

4. In the first place, it becomes necessary to visualize very briefly the Latin American development process during the last decade. Since the mid 40's, the analysts of the process have devoted a special attention to the crisis of the traditional "outwards" development model based on the export of primary, agricultural, mining and other similar products. Concurrently, the need of an alternative model was outlined, designed to allow a "Rostowian take-off" towards a self-sustained development, based on the development of the countries own resources, supported by industrial development and import substitution, with the assistance of international capital and financing. During the 50's, the main topic was the creation of a broadened Latin American market as a means to ensure the long-term feasibility of

an "inwards" growth model by means of captive markets and scale economies.

5. The 60's saw the formulation of an "underdevelopment theory" in Latin America, as a result of the analysis of the politics-economy-development problematic. Based on the analysis of the resulting economic and technological dependency relationships, it was possible to prove not only that the take-off had not taken place, but that the center-periphery gap had widened, and that the economies of the central countries had been able to consolidate at the expense of the peripheric ones by means of a powerful penetration instrument: the transnational companies.

6. Only recently it has come to be realized that internal integration and self-sufficiency in terms of manufactures are insufficient indicators to measure the impact the industrial development has on the integral economic and social development. The model is actually questioned. Historical experience has shown that this approach has proved to be incapable of generating sufficient employment, increasing the levels of higher productivity among the work force, ensuring a just distribution of income, increasing the people's access to education and culture, allowing the national economies to establish an adequate control of their own internal and external flows, and of strengthening the relative position and autonomy of the region's countries vis-à-vis the more developed countries.

7. Diamant has elaborated an interpretation of this reality and the possible resulting tendencies, identifying four development models:

I. Pre-industrial unprotected economies;

II. Autarchic economies, strongly protected (based on import substitution of final and intermediate products and capital goods);

III. Economies in process of a recessive opening (based on a gradual or sudden reduction of that protection);

IV. Economies in process of expansive opening (based on the promotion of industrial exports as a step further from import substitution, emphasizing engineering and capital goods).

In general, there has been a sequence between models I and II. In many cases, balance of payment problems and the adoption of stabilizing plans of the International Monetary Fund type, have led to model III, or even to an unstable swing between models II and III. Very rarely model II has developed into model IV.

Diamants makes an excellent analysis of the entrepreneurial behaviour in relation to these models.

8. One of the expressions of the prevailing dualism are the criterion of supporting the modern industrial sector neglecting the traditional sectors, which play a highly important role in the national gross product, balance of payments, employment patterns, income distribution, etc.

III. Technology

9. In the broadest sense, technology may be defined as "the ordered set of all knowledge used in the production, distribution (through trade or any other means) and use of goods and services. Therefore, it covers noy only the scientific and technological knowledge obtained by research and development, but also that derived from empirical experiences, tradition, manual skills, intuitions, copying, adaptation and so on. Technology may be incorporated to capital (capital embodied) in the form of machinery and equipment, or in human resources (human-embodied) through locally trained individuals, foreign experts, skilled immigrants, etc., or may remain as explicit technology (disembodied) in the form of documents, books, manuals, blueprints, formulas, diagrams, journals, and so forth."

10. It is important to emphasize the ways in which the production modes of technology have evolved, as they have an enormous influence in the characterization of dependency:

    i. handicrafts: until the end of the last century, isolated inventors.

    ii. manufacture-workshop: creation of industrial laboratories in which scientific and technological researchers live together in the same premises. It develops the concept of technology as a commodity.

    iii. Factory: the computers and simulation models, the cybernetic devices and highly sophisticated equipment are incorporated into the daily activities of the industrial research laboratories.

11. In the words of Goulet, "Technology affects development on four counts: It is a major resource for creating new wealth; it is an instrument allowing its owners to exercise social control in various forms; it decisively affects modes of decision-making; and it relates directly to patterns of alienation". In this same context, Sábato concludes: "Thus, at the same time that technology has brought modernization and progress to every country, it has increased the political and economic power of the industrialized nations while producing technological dependence and cultural alienation in the less developed countries. Technology as a carrier of cultural values, reinforces the cultural dependency of the developing countries.

12. In those countries, the need of adopting appropriate technologies, of avoiding the harmful effects of an uncontrolled industrialization process, of preserving and developing an indigenous culture, and reducing the technological and cultural dependency, determines the need of attaining a complete control of technology.

Stating this concept in a positive way, Sábato defines appropriate technology as "that contributing to provide for the basic needs of humanity and to attain the full development of its capabilities, utilizing the available resources in such a way that it will not lead to man's exploitation or subjugation nor to the inevitable destruc-

tion of nature". Obviously, most of the technology currently utilized does not respond to this definition.

IV. Technology as a "variable" of integral development

13. Perhaps the principal reorientation of technological policies in several developing countries during the last years, is that they have ceased to view technology as "data", and have begun to see it as a "variable or dynamic instrument of integral development". This implies the possibility of choosing among several technological solutions and therefore, diversifying the sources of supply, increasing local participation, reducing costs and increasing self-reliance in the developing countries.

14. The problems arise from the initial stage of design and implementation of policy instruments. While in a worldwide context, experience in economic policies (monetary, fiscal, credit, tariffs, income and investment policies) is several hundreds years old, the experience in design and implementation of technological policy instruments only dates from the last two decades. In developing countries, and in Latin America in particular, this difference in time is magnified and becomes more serious. The Latin American countries are still searching for criteria to correlate the objectives of their economic and social policies and their technological development policy. Although one should be developed within the other, the

definition of such objectives and criteria represents in essence the struggle between short- and long-term objectives. In other words, the option between an accelerated economic and industrial growth and the foundation of a future self-sustained economic and industrial development. Unfortunately, the already mentioned lack of institutional continuity forces the predominance of short-term objectives and immediate economic results, conflicting in many cases with social goals.

15. Technological development may be attained through the transfer of technology or technological innovation. As most of the developing countries still have a limited capacity for technological innovation, such development is usually pursued through the international transfer of technology (also called "relative innovation").

16. It is well known, especially in Latin America, the negative aspect of "mimetic transfers", not suited to the local production factors, as well as --above all-- their inhibitory effect on research and development activities in the recipient countries. In the developing countries, the problem is not only the access to technology, but the actual possibility of its absorption and adoption. In these countries, the objective of the process of national technological development is to attain an increasing capability for technological innovation through the control of the import, use and adaptation of available foreign technologies.

considering technology, at the same time, as a variable of the process of integral development, trying to optimize solutions based on the course of relative prices, resource availability and the structure of the demand. This implies the incorporation to the technological development policies, of the dynamic characteristics of technical change. Thus, it becomes essential to analyze and to establish criteria to evaluate the technological alternatives, bearing in mind the parameters that characterize the technology and which, at the same time, differentiate it in terms of countries: availability of raw materials, profile of the technical know-how, production scale, product specifications based on the country's consuming patterns, input mix, etc.

V. Evaluation and selection of technology alternatives

17. It is necessary to ensure that the process of evaluation and selection of alternatives embodies the widest margin for decision, with the greatest possible number of options. Several considerations may be derived from the analysis of the various ways of increasing those options:

18. a) To ensure the definition of the needs to be satisfied (related to the consuming patterns) instead of the specifications of products already designed.

19. b) To ensure that the evaluation process includes not only the "substitution" of foreign sources and inputs by local ones, but also its

"complementation" with social evaluation criteria. This implies the need to optimize the equation of technological flow through the optimization of the relationships between domestic and imported technology. At this point, the conflict between short- and long-term objectives emerges again. A greater use of local inputs, even though not currently available, implies an increase of the process's adaptative potential. As stated by Sercovich: "to appraise the future against the present". A correct appraisal of the "technological risk" involved in such a decision becomes essential.

20. It is important to remark that production does not consume the technological inputs, but "enriches" them. Plant maintenance and operation activities constitute sources of innovative ideas that modify, creatively, the technological input.

21. These minor innovations originated in the productive unit itself (Theory of endogenous technical change) are accompanied by externally generated or adapted knowledge (even from the scientific-technological infrastructure). This outlines a "process of technological learning" that modifies the productive structure and the profile of the available capability and, in turn, allows an active absorption of technology through the action of "learning by doing." We obtain, in this way, a continuous accumulation of technological storage.

VI. Technology as a "package"

22. According to Sábato, "the package approach" as a model for the analysis of technology is an answer to the multidimensional nature of technological change-a model that has the flexibility to incorporate all the inputs into the process of technology production without losing sight of their distinctive functions and purpose.

23. i. One key characteristic of a given technological package is its design specificity, i.e., it is designed to perform a precise function in the productive structure. Therefore, the leading principle of its design is that its various components (knowledge from different sources) are chosen and utilized so as to get the desired result. So, it does not really matter if that knowledge is original or not, scientific or not, produced by in-house R and D or bought from a supplier, adapted from an old technology or recently invented, obtained locally or imported, etc., provided that the skilled combination of all the necessary elements gives the right package, i.e., one that can perform the assigned function with maximum efficiency.

24. ii. In fact, the only way to get the desired package is by a long, painful and expensive process of "debugging", through which the technology gets its final adjustment to real conditions.

25. iii. Precisely, one of the most serious problems faced by the developing countries is the lack of specificity to local conditions that imported technology presents. This fact determines the

importance of an instrument which has proved to be both effective and potent: the opening or breaking down of the technological package. Whenever it has been used, it has shown the advantage of the full utilization of the local installed capacity. Also, along with technological development policy instruments such as the financing of prototypes or risk capital, it has allowed the preparation of capacity for the future. An important complementing element is the utilization of the purchasing power of the State.

This defines very clearly a double capacity: to break down technological packages and to rearrange them incorporating local inputs.

VII. Role of the consulting and engineering activities

26. The activities related to the technological development begin with the reinforcement of the scientific-technological infrastructure, and include the organization of technological services for the industrial sector, ending with the various stages involved in the formulation, organization and launching of an industrial project. They are related to availability of information, technical assistance, studies, training and hiring of specialized personnel, decision-making processes, delegation of responsibilities, business organization, etc. The number and importance of activities vary in each case, according to the technological needs of the productive sectors involved and the size of the production units and, on the other hand, to the technological capability of such sectors.

27. Obviously, in the degree in which the activities susceptible of assimilating the various techniques that will be transferred along the process (basic engineering, production engineering, management, marketing, etc.) are well developed at a national or local level, the need of technical assistance once such facilities are started up will decrease accordingly.

28. Experience has demonstrated that feasibility studies and preliminary investment projects constitute the strategic phase of technological development. During this phase, the weaknesses of the decision-making process in the developing countries, are due mainly to: i) insufficient knowledge of national technological innovations; ii) influence of international consulting firms and suppliers of equipment and capital goods on the selection of technological processes; iii) lack of a real capacity to evaluate technological options on the part of the buyer.

29. The lack of an autonomous structure in international consulting and engineering determines that usually the selection of an engineering firm implies, in fact, the selection of the technological process. In general, the consulting and engineering firms currently operating at an international level, maintain close economic or operational relationships with specific groups of owners of processes and suppliers of equipment. This circumstance limits, conscious or

unconsciously, the degree of objectivity of their evaluations. In order to make a real evaluation, the problem should be reversed: a preevaluation of technologies should be made first, and then the consulting and engineering firm should be selected, preferably a national firm.

VIII. Registers of transfer of technology and preinvestment

30. From the diagnosis performed in Latin America in the late 60's, a defensive policy was formulated (Resolution 26 of the Cartagena Agreement). This activity has contributed to clarify certain aspects of the contracts involving technology transfers, eliminating the inclusion of restrictive clauses, improving the conditions and amount of royalties, etc. In short, it has improved noticeably the contractual aspects, although it has had almost no effect over the technology selected. The presentation of a contract implies that prefeasibility and preinvestment studies have already been performed, that the basic engineering has been defined, and, most probably, that detail engineering is already advanced.

At this stage of an industrial project, technology is already "data", and not a "variable". In order to avoid this irreversible process, the technological package should be broken down at the prefeasibility or preinvestment studies level.

31. Therefore, in order to ensure that technology is incorporated as a variable to the development process, the following steps are required:

a) modification of the methodology related to project formulation; b) modification of the current decision-making processes (optimize them, improve them, and explicitly formulate the factor called technological management; c) incorporation of a technological evaluation at the prefeasibility studies level (opening of the technological package).

32. The previous points stress the importance of the role played by the preinvestment funds (the integration of preinvestment in the technological negotiation) and the development banks usually financing this activity. In this way, we are again confronted with the need of an autonomous consulting and engineering capacity as an expression of a realistic attitude that implies an aggressive and dynamic technological development policy.

An additional element to be taken into consideration is the lack of an adequate follow-up of the impact of contracted technologies, by the Registers of Technology Transfer. Such information is essential to define and implement a technological development policy.

33. The consulting and engineering firms, the preinvestment funds and the development banks are only some of the policy instruments that should act coordinated and coherently with the other instruments and with the incentives and stimula to the productive sector, in order to attain an autonomous technological development. The Science and Technology Policy Instruments Project, developed by

the IRDC from Canada and the OAS, has contributed to clarify many of the questions, stressing basically the importance of implicit instruments. The final report of the project is presently being published.

IX. The action in Latin American countries

34. Most of the above mentioned elements in relation with the topic of this meeting, have crystalized in the Specialized Conference on the Application of Science and Technology to the Development of Latin America, organized by the OAS and held in Brasilia in May 1972. It has been the most important international meeting of its type held in Latin America in the past decade. Any analysis or discussion of problems in science and technology should pay careful attention to most of its conclusions and recommendations, as contained in the final document entitled, "Consensus of Brasilia." (See Annex 1).

35. The importance and relevance of CACTAL derives from the depth of its analysis of central topics, its concern with an overall social, economic and political approach, the serious advance work done by most of the delegations which minimized rhetorical considerations, and finally, the extreme frankness and clarity of the dialogue between Latin America and the United States. The most important result, which should not be forgotten or left out of future negotiations, was the affirmation by the Latin American countries of their willingness to achieve technological autonomy, as expressed in the Declaration of Principles of the Consensus of Brasilia: "3. The member states

reaffirm, as an essential condition for the full exercise of national sovereignty, without impairment to regional cooperation, the need to strengthen their capacity to make their own decisions regarding creation and adoption of the science and technology required for the development of their peoples." The text goes on to say:

"The objectives of an overall, integrated strategy should include narrowing the technological gap, eliminating technological dependence on the developed countries..."

36. Other relevant activities in Latin America, complementing CACTAL, are: i) the Pilot Project on Transfer of Technology (OAS), ii) the Science and Technology Policy Instruments (IRDC) and iii) the Research Program in Science and Technology (IDB/ECLA).

37. An analysis of the results of the pilot project reveals several major points:

1) The sectorial approach made it possible to test several specific instruments and mechanisms for transfer of technology, especially as they pertain to aspects that generally had been underestimated in previous analyses of problems such as the detection and formulation of the explicit demand for the technology requirements of the productive sector; 2) the feasibility of combining into a system the needs of the productive sector and the installed capacity of the national scientific and technical sector was proven; 3) the advantages and possibilities of having intermediary assistance agencies participate

in advising and increasing national negotiating capacity purchases of technology abroad were proven; 4) detailed identification was made of the characteristics and nature of the best technical, economic and marketing information for the selection, purchase and adaptation of the technology alternatives best suited for the individual nations; 5) finally, the advantage was demonstrated of a coordinated search for solutions to the technological needs detected, beginning at the level closest to the unit requiring them and expanding the search successively to the national, subregional, regional and world levels.

38. The Pilot Project on Transfer of Technology likewise showed that the different national mechanisms for transfer of technology could be coordinated and that such coordination constitutes the logistical base for the design of a national technical policy to optimize the relations that it leads to at the international level. This coordination would be helpful in converting from a situation of heavy technological dependence --as seen in most of the countries of the region-- to different forms of interdependence, increasing self reliance in the developing countries. This is not necessarily proportional to the volume of technology imports of a country, but to the forms of purchase and the quality of the flow resulting from the import and supply of national technology. Its clearest manifestation is the real degree of autonomy of national decision-making in choosing the kind of technologies to be imported.

An important aspect of the results of the project was the definition of the role played by information in the processing of technological requirements. Part of that experience is presented in Annex 2.

39. The Research Program in Science and Technology, a project co-sponsored by the Inter-American Development Bank and the Economic Commission for Latin America, is analyzing the problems of the relation between technical change and development stage in certain countries. In Argentina, Brazil and Mexico, the analysis focuses on the phenomenon of late industrialization.

An important aspect in this project is the microeconomic analysis of the technological modernization process in relation with the entrepreneurial structures, which has generally been underestimated.

X. Technological Management

40. - The Technological development strategies, policies and plans established by the corresponding national agencies for guidance and coordination have been frustrated on several occasions by distorted, partial or nonexistent implementation in the institutions established to carry out the research and development and to provide technological services, as well as in the private and public enterprises. This has occurred due to discrepancies among the major technological decisions made by the central agencies of the government sector on the one hand, and due to the minor technological decisions made by research and development institutions and as well as enterprises, on the other hand. Such discrepancies emerge from the use of inadequate governmental policy and/or from the lack of organizational structures and operational methods suited to the process of technological decision making and implementation in those agencies and enterprises -- in other words, to the lack of appropriate technological management. It is necessary to design a Program to compensate the shortcomings in supervision and administration of enterprises and individual technological services agencies, among which research and development institutions have a prominent place.

41. - As we pointed out, at some Latin America's countries current stage of development, the policy of import substitution tends to be replaced by strategies promoting access by the national economies, by economic contradictions generated by the previous model II and by the increasing international economic interdependence. Through these strategies, the model III tried to increase competition by eliminating protectionist barriers in the domestic market, and increased exports are sought. Now more than ever, progress and even survival of the national productive structures make it necessary to resort to the possibilities offered by scientific and technological knowledge.

42. - This knowledge must be applied to the development of new or improved products in order to penetrate markets, and to new processes to reduce costs through better adaptation of production to local raw materials and factors.

In view of these requirements, developing an understanding and/or desire for technical change and efficient technological management becomes an urgent requirement of every development process. Enterprises need to mobilize their own resources and to seek external resources in order to maintain themselves technologically up to date and to find original technological solutions which will enable them to keep ahead of competitors. In this endeavor, they require varying degress of support in several fields of technological

management, including the following:

- Analysis of technological profiles of the enterprises, including comparisons with enterprises in more advanced countries.
- Formulation of technological strategies;
- Technological decisions which will take advantage of current opportunities;
- Internal organization of the adaptation and innovation processes, and of research and development of products and processes;
- Technologically sound plans for the maintenance and replacement of equipment;
- Gathering, conservation and provision of technical information to meet domestic requirement;
- Acquisition of technologies;
- Technical training;
- Selection of equipment for research and development projects and for technological standarization and control;
- Promotion of technical creativity in business
- Consideration and management of patents;
- Marketing and sale of suitable technologies;
- Identification and selection of advisors on technological matters; and
- Recognition of the services, possibilities and advantages that may be offered by the national technological infrastructure.

43. - The central problem of Latin American business as it relates to technological management is the fact that such management is not recognized as a function of prime importance and specialized nature among the other supervisory and administrative functions. This implies the lack of an overall integrated and balanced perspective of the problems and solutions of business technology. Therefore, activities related to technology are undertaken separately, and possibilities for mutual support are lost, unnecessary duplications occur, and available options are not fully considered.

44. - Special attention should be given to the medium-and small-size enterprises, which, despite their unfavorable position from many standpoints, provide a substantial part of production and employment in the industrial sector. These enterprises generally lack the necessary resources to maintain specialized personnel for technological management and often are even short of the technicians required to conduct adequate current production process. This could be at least partially offset through the individual support of research and development institutions and technological services to the medium-and small-size enterprises. However, so far the activities of these institutions have, in many instances, not been adequately linked to the production problems of production companies. In fact, a substantial part of the capacity of such institutions remains totally unused or is devoted to research in areas of a marginal national

interest. This situation certainly points to the need to reevaluate the management process of research and development agencies and technological services.

45. - In this review of problems, stress should be made on the shortage of projects which involve original applications of science and technology to solve production problems related to individual national traits, such as the desirability of utilizing raw materials with special characteristics, the need fo · adaptation to the environment, the unsatisfied demand for traditional native products which are sought by national consumers or which could be exported. This shortage is due at least partly to a lack of training in identifying, formulating and implementing technological development projects.

46. - Of equal or perhaps more importance is the inadequate attention devoted to technological problems in certain phases of investment project formulation, particularly during the feasibility and preinvestment studies. Experience has shown that the technological approach of the projects is traditionally biased towards the use of foreign conventional technologies even though such an approach may not be the most desirable. Much more serious still is the non-utilization of the manufacturing capacity of the country. Ensuring the opening of each project's technological package is fundamental, and poses the need to promote continuous attention to technological matters during the project's entire development, establishing the management instruments suited for each phase.

XI. CONCLUSIONS

47. The preceding notes and experiences contain a general overview of some relevant aspects of the technological development process in Latin America.

The permanent iterative interplay of diagnosis-theory-action-evaluation has enriched the process and allows the identification of many elements and instruments that merit an in-depth analysis.

Regardless of priorities and not intending to be exhaustive, the following aspects may be mentioned:

1. Information -structured from the point of view of the user and developing a capability for analysis and construction of processed technical-economic information.
2. Analysis of the alienating characteristics of technology, basically as a carrier of cultural values.
3. Need of better methodologies to evaluate and select technological alternatives, including social, psychological, ecological aspects. Relationship between technology and quality of life. Technological forecasting.
4. Noticeable deficiencies in the utilization of technology in basic needs such as housing, health, nutrition, etc.
5. Need of redefining the role of industrial technological research institutes.
6. Objectives and structure of the Institutes of Methodological Standardization

and Rationalization. Productivity Centers.

7. Increased knowledge of consulting and engineering services. Differentiation between assets and technological services.
8. Need of more dynamic and precise concepts regarding quality management.
9. Analysis of the problematic inherent to institutional conflicts, either among institutions or within them.
10. Analysis of the permanent destruction of human resources by periodic political crises.
11. Need of a sectorial approach. Development of the concept of "technology regime". Design and methodology for the elaboration of sectorial profiles.
12. Stimula and incentives to the technological development of the productive sector. Importance of preinvestment and risk capital financing.
13. Development of the concept of "technology enterprise", materializing it in some pilot projects.
14. Detailed analysis of the role of the state as producer and consumer of goods and services.

    Establishment of a closer relationship between that role and its functions as strategist and policy-maker, promoter and planner. (Policy organisms; Foreign Trade Institutes; royalty committees; Registers of Transfer of Technology, Foreign investments, etc.)

15. Need of structuring organized national mechanisms of technological development, harmonizing the various agents, arenas, and levels of action through which the process evolves.

16. Need of training the human resources required to administer all these aspects.

A clear formulation of technology in order to incorporate it dynamically to the development process.

This last aspect has precisely been emphasized in this presentation.

ANNEXES

1. The Consensus of Brasilia

2. Role of information in the processing of technological requirements.

3. A Technological Management Program. Objectives and fields covered.

THE CONSENSUS OF BRASILIA

On the Application of Science and Technology to Latin American Development

Preamble

THE SPECIALIZED CONFERENCE ON the Application of Science and Technology to Latin American Development (CACTAL) finds its inspiration in the Declaration of the Presidents of America, who, at the meeting held in Punta del Este from April 12 through 14, 1967, recognized the decisive importance of science and technology to the development of Latin America.

The Presidents of the American Republics affirmed on that occasion that "Latin America will share in the benefits of current scientific and technological progress so as to reduce the widening gap between it and the highly industrialized nations in the areas of production techniques and of living conditions." They further agreed that "national scientific and technological programs will be developed and strengthened and a regional program will be started; multinational institutes for advanced training and research will be established; existing institutes of this kind in Latin America will at the same time be strengthened and contributions will be made to the exchange and advancement of technological knowledge."

Likewise, they stated that "science and technology offer infinite possibilities for providing the people with the well-being that they seek. But in Latin American countries the potentialities that this wealth of the modern world offers have by no means been realized to the degree and extent necessary." They also affirmed that "science and technology offer genuine instruments for Latin American progress and must be given an unprecedented impetus at this time. This effort calls for inter-American cooperation, in view of the magnitude of the investments required and the level attained in such knowledge. In the same way, their organization and implementation in each country, cannot be effected without a properly planned scientific and technological policy within the general framework of development."

In the spirit and letter of the Declaration of the Presidents of America, the Latin American countries expressed in the Consensus of Viña del Mar (May 1969) their willingness to convene an inter-American meeting on the application of science and technology to Latin American development. Determined to put this aspiration into effect, The Eighth Special Meeting of the Inter-American Economic and Social Council, held in Caracas in February 1970, the First Special Meeting of the Inter-American Council for Education, Science, and Culture, held in Washington in April 1970, and its Second Regular Meeting, held in Lima in February 1971, recommended that a specialized conference be held; and the General Assembly of the Organization of American States, at its first regular session (San José, April 1971), endorsing to that recommendation, convoked the Specialized Conference on the Application of Science and Technology to Latin American Development, to be held in Brasilia in May 1972.

CACTAL is therefore a response to the political decision to give impetus to an eminently dynamic process intended to mobilize Latin America for the systematic application of science and technology to accelerate the region's development.

Strategy for Scientific and Technological Development in Latin America

The systematic and continuous application of science and technology to the over-all development of Latin America, at the national and multinational levels, demands that each country shall first of all define its over-all development strategy. This definition shall take into account the fact that scientific and technological policies must be geared to the permanent objectives of that strategy concerning economic growth, social justice, and the enhancement of culture.

Concern over the attainment of social justice should be translated into adoption of the suitable development policy instruments in each country that will ensure that its technical and scientific component will contribute effectively toward attainment of the goals of full employment and full utilization of human resources.

It is the sovereign right and the duty of the states to define the major objectives of their overall development. The formulation of comprehensive national policies and plans constitutes the frame of reference of the scientific and technological effort that the accelerated progress of the peoples of Latin America demands. Consequently, it is urgent to design, determine, and apply national policies on science and technology that are closely coordinated with economic and social development policies. The agencies responsible for policies on science and technology should be located at a high level in the political and administrative structure of the respective states so that they may truly participate in the decisions that directly or indirectly, affect those policies.

Overall strategy for scientific and technological development should seek the continuous interrelation and coordination of the pertinent activities of the governmental sector, the productive sector, the financial sector, and the scientific and technological system.

The objectives of an overall, integrated strategy should include narrowing the technological gap, eliminating technological dependence on the developed countries, and advancing toward the creation of indigenous technologies.

The Latin American countries need to strengthen and reorient their domestic scientific and technological systems with a view to absorbing, adapting, and generating technologies. This requires increasing applied and experimental research and conducting properly oriented basic research that will serve those systems as an input.

To achieve the goal of technological modernization, the Latin American nations should orient their respective national development policies toward the best possible utilization of economies of scale and toward strengthening national production systems through improvement in the technological and managerial capacity of enterprises.

Domestic resources should, in general, be the main source of financing for national efforts aimed at development of the scientific and technological systems of the Latin American countries. The policies for execution—fiscal, monetary, trade, and so on—of the development strategy should include, among their major objectives, the capacity to allocate sufficient resources so as to increase those devoted to scientific and technological activities, ensuring stability, continuity and efficiency in their implementation.

External aid should supplement domestic efforts, should be oriented by the country receiving it on the basis of integrated programs as regards scientific and technological planning, and should be geared to priority needs.

Program for the Application of Science and Technology to Latin American Development

The CACTAL deliberations have shown that there is a consensus among the member states of the Organization of American States as to the need for a regional cooperation strategy, coordinated with national policies, on the application of science and technology to the development of Latin America. At the same time, from the conclusions, proposals, and resolutions that have been approved, there stems a broad action program that seeks to adjust the scientific and technological system to meet the demands of economic and social development.

The considerations and general programing elements contained in the decisions of the Conference are presented here in the order in which the topics were listed on the agenda.

The areas of action in science and technology depend on the special circumstances of each country, on its development strategy, and on its economic structure and social organization. However, it is recognized that in many cases the Latin American countries have certain common interests.

To identify overall and sectoral demands and determine the resources required for research, it was considered that suitable methodological instruments should be perfected, and an institutional framework established, to permit cooperation between the agencies responsible for economic and social planning and those responsible for scientific and technological planning.

It is therefore necessary that an effort be made in each country, with the joint participation of the agencies responsible for economic and social, and scientific and technological development policies, to identify, in the short- and medium-term plans and in the economic and social development strategies, concrete problems that scientific and technological research can help solve.

Creation and Development of Technology

For the training of human resources, and the strengthening of research institutes and of incentives for scientific and technological research in Latin America, the Conference established the following general guidelines:

Determination of manpower requirements in the long term demands a view of the prospects for the type of development and the quality of life to which the society aspires.

It is the basic responsibility of each country to foster a demand for science and technology, to adopt the necessary measures and provide the resources that will make it possible to attain the goals the government has set for itself, and to utilize available human and material resources with maximum efficiency in order to develop priority research areas at the national and regional level.

National policies on human resources should take into account the most urgent priorities connected with the quality of education, the structure and content of higher education, and the adequate use of available resources.

Without prejudice to its fundamental objectives, the educational system should contribute to the scientific and technological development process through a broad and flexible structure geared to the current status of knowledge at all levels and in all areas and incorporating specific knowledge on priority fields of development. In this regard, education should train the individual so that he will contribute to the production process and continue to acquire on the job or through special studies, the knowledge demanded by the needs of society.

Relations between institutions of higher education and the production system should be oriented in such a way that teaching and research activities will meet the requirements of the labor market and of national scientific and technological development.

The application of science and technology to development calls for a vigorous scientific and technological system that can be integrated into the production system and that can contribute to its technical progress. Accordingly, it becomes necessary to strengthen basic and applied research institutes, particularly those that contribute to technological innovation. It is also necessary to encourage research workers in their dedication to scientific and technological creation, recognizing their important role in society, since the results of Latin American development programs depend to a large extent upon their contributions.

The planning of the scientific and technological system demands an overall evaluation of human resources. This evaluation should be the responsibility of each government, although it is advisable to establish a uniform methodology for analysis at the regional level.

In order to train human resources in sufficient quantity and adequate quality, it is necessary to increase the capacity for advanced research and development. Measures should also be adopted to reduce the causes of emigration of national scientists and technicians and to encourage those working abroad to return.

The state should play a dominant role in the financing, encouragement, and orientation of scientific and technological activities through the appropriate mechanisms of economic policy, particularly fiscal and financial ones, and by using its strong power in purchasing goods and services.

It is important to establish concerted scientific and technological research plans that will be shared by the government, the scientific community and the production system.

Technological Innovation and Transfer of Technology

Technological innovation and the transfer of technology to the Latin American countries were considered by the Conference in terms of national and regional demand, taking into account the various aspects, costs, and difficulties of transfer and the problem of incorporating innovation into the production system. The following points were stressed:

Scientific and technological development should aim at efficient modernization of the production system by creating and strengthening the technological, financial, and management capabilities of government organizations and enterprises. It should give preferential attention to the needs of both rural and urban marginal sectors and to development of the most dynamic sectors of the economy that make intensive use of advanced technologies.

In the sphere of the national development policies of each Latin American country, technological policy should be oriented toward selection and adaptation of the technology transferred and toward fostering the creation of local technology under the conditions best suited to the structure of the production factors of each country, especially taking into account the employment policy and the measures that directly or indirectly influence relative costs of labor and capital.

To meet the demands of science and technology, the best possible use should be made of the world's store of knowledge, which implies adapting the processes to the levels of activity of domestic industry, adjusting the relative use of capital and labor as required, in view of their relative scarcity, and investigating the possibility of using local products and developing the necessary processes and equipment.

The scientific and technological system should be oriented preferentially toward meeting the needs of marginal rural and

urban populations, through an interdisciplinary and local technological research and development effort. To attain this objective, the innovating effort should be directed toward utilization of locally available materials and improved efficiency of the resources family and community groups can devote to supplying their own needs and producing for the market.

Latin American countries should take steps toward closer coordination between centers of applied research in the fields of agriculture and industry, in order to industrialize rural zones.

Latin American countries should create and develop basic and applied research in selected fields for expanding exports.

It is advisable that each country study the consumption patterns by socioeconomic groups and regions, in order to determine the corresponding technological component.

The transfer of technology from developed countries to Latin American countries, as well as among the countries of the region, is one of the most important factors in their overall development, provided the nature and accessibility of the technologies transferred are geared to the development goals and take into account the commercial interests and the resources of the recipient countries.

Latin American countries should formulate policies for transfer of technology, designed to achieve the following ends, among others:

That the corporations supplying technology also provide information and training for local personnel;

That contractual or other restrictions be removed, as between national and foreign corporations or their subsidiaries in Latin America, that prevent full use of the technology imported;

That foreign enterprises allocate a percentage of their budgets to finance research in Latin America;

That national research institutions and technology enterprises be given preferential treatment in connection with the requirements for advisory services to the country's production system;

That whenever pertinent, the creation of Latin American multinational corporations that generate and market technology under competitive conditions in the world market be encouraged;

That agreements on transfer of technology be noted, examined, evaluated, selected, improved, and approved.

The strengthening of the native capacity for technological innovation in Latin American countries should be oriented preferentially toward solving problems peculiar to the region (development of labor-intensive techniques and others related to the use of local materials, taking into account the basic needs of the population) and toward areas in which the technological component is a key element in international competition or in attaining goals. Moreover, national technological capacity should be used to ensure that the process of international transfer of technology will be carried out according to the conditions described above.

Industrial property systems in Latin American countries should serve the socioeconomic development objectives in each, within a framework contemplating common Latin American interests. To this end, the countries of the region should carry out individual or, when appropriate, joint studies on patent and trademark legislation in force in Latin America and elsewhere, in order to adjust such legislation to development objectives.

Taking into account the fact that attainment of the objectives of scientific and technological policies is, to a large extent, based on improving active information systems responsible for selecting, analyzing, and spreading information useful to users, the Latin American countries should create adequate institutions to meet this need. Coordination among the various scientific and technological information mechanisms is the essential basis for their integration into a national system, which will bring about a single integrated regional information system.

In view of their size, their impact on the economic system, their dynamics, and their access to credit, government-owned enterprises should develop adequate mechanisms for integration into the scientific and technological system. These enterprises should play an important role, both directly and indirectly, in scientific and technological creativity in Latin America.

It is advisable that the Latin American countries encourage the establishment of specialized technical assistance centers that will support the development of national industry and provide, among others, advisory services in connection with management and organization techniques, market research, and development of products and processes.

In the transfer of technology, the Latin American countries should pay special attention to measures designed to decrease excessive costs of such transfer, especially in connection with the balance of payments.

Cooperation for Scientific and Technological Development

In the policies, planning, and financing for scientific and technological development, the following programing elements should be stressed:

The Latin American countries should have institutional mechanisms at a high level in the political and administrative structure that would enable them to formulate their national policies and plans on science and technology within the sphere of development planning. Though considerable progress has been achieved in the establishment of national science and technology councils responsible for scientific and technological planning (in some cases at the ministerial level), those councils must now be strengthened and consolidated.

Policies on science and technology should cover all aspects of technical development, that is to say, the creation, dissemination, and application of scientific and technological knowledge, as well as control of the transfer of technology from abroad.

National planning of science and technology should allow for the identification of areas in which international cooperation is feasible.

The planning policy for the scientific and technological effort in Latin America should be oriented toward full cooperation among the Latin American countries and toward identification of common aims for the solution of specific problems.

External aid for the scientific and technological development of Latin America, to supplement each country's internal effort, should be governed by the following criteria:

It should be oriented by the recipient country and be geared to its priority needs;

It should be provided on the basis of programs integrated with national scientific and technological planning, which should clearly indicate how foreign contributions would supplement national resources;

It should contribute to develop the recipient country's capacity, so that it may reach a sufficient level of autonomy to use the appropriate foreign technology for the project;

It should be gradually replaced by local contributions within a period depending on the nature of the projects involved;

It should be guided by the principle of making the best use of international resources;

Clauses should be eliminated that provide that it must be foreign experts and consultants who evaluate and advise on externally financed programs;

The installed capacity and infrastructure in the recipient countries to be used in the pertinent projects should be taken into account as a counterpart contribution; and

It should be as flexible as possible for most efficient use.

Instruments for Action

For the purpose of effectively carrying out the policies and action program approved by CACTAL, in compliance with the criterion of avoiding the creation of new administrative agencies by adequate coordination and rationalization of existing ones, a series of activities and measures have been indicated for the application of science and technology to the development of Latin America.

COORDINATION ACTIVITIES

It is deemed necessary to have coordination and ties between the Inter-American Council for Education, Science, and Culture (CIECC) and the Inter-American Economic and Social Council (CIES), and likewise between their Permanent Executive Committees, with the aim of avoiding duplication of activities, speeding up action, and evaluating on a continuous basis the region's scientific and technological development programs, and a permanent coordinating mechanism is recommended.

EVALUATION AND REVIEW ACTIVITIES

It was decided to establish a Group of Experts appointed by each member state to evaluate and review the Regional Scientific and Technological Development Program and the other programs of the Organization related to the application of science and technology to development, and to propose to the pertinent organs of the OAS criteria for the restructuring of those programs. The experts should also establish suitable procedures for implementing the decisions reached at the Conference by improving those programs so that their activities will contribute to the implementation of national plans on science and technology and so that the results thereof will be incorporated into social and economic activities. The Group of Experts should take into account the priorities established by the organs of the Inter-American system in the areas of science and technology.

PLANNING ACTIVITIES

Approval was given to the drafting of an indicative plan on integrated science and technology which will reflect national priorities, with due regard to the order established by each country, and which will also point out areas of common interest.

It was decided that the pertinent organs of the OAS, through the Executive Committees of CIECC and CIES, authorize the Secretary General to convoke a group of government experts appointed by each of the member states, to be entrusted with the following specific tasks:

To evaluate, review, and propose criteria for restructuring the Regional Scientific and Technological Development Program and all other OAS programs that might contribute to scientific or technological development or in whose execution applications of science and technology are important, duly taking into account the priorities established by the governments and giving special consideration to the needs of the relatively less developed countries.

To propose the bases for the indicative integrated plan mentioned above, and to determine the instruments of the Inter-American system whose participation is required for its drafting and approval.

The group's report shall be transmitted to the member states for consideration at the forthcoming regular meetings of CIECC and CIES. The group shall take into account the pertinent resolutions of CACTAL.

Specific Action Recommended by CACTAL

The complete texts of the recommendations listed below appear in the corresponding chapters of the Final Report of the Conference.

TO THE MEMBER STATES:

Analysis of the resolutions of CACTAL in each country, by the responsible agency or the National Committee for CACTAL.

Creation of financial mechanisms for:

Granting fellowships and loans for education, to attract students to courses of study of the highest priority for development;

Permitting exchange of academic staff and students among universities; and

Financing fellowships for study abroad and providing material and financial means for the holders' work when they return to their countries.

Creation of labor market orientation centers.

Allocation of resources for science and technology by program.

Establishing and strengthening bureaus for formulating and evaluating technological projects.

Introducing modern administrative methods in research institutes and mechanisms for ready communication with the productive sectors.

Studying the possibility of making multiannual budgetary contributions to research institutes of the public sector and of allowing freedom in the use of grants and resources obtained from the sale of services, patents, and so on.

Establishment of an institutional basis for joint studies of the economic-social and scientific-technological sectors, to identify specific development problems to be dealt with through a technological effort.

Establishment of concerted scientific and technological research plans.

Establishment of research institutions in priority areas of development, such as:

Attention to marginal rural and urban populations;

Lines of export;

Utilization of natural resources; and

Modernization and promotion of handicrafts and small industry.

Establishment of specialized centers for developing and marketing new products.

Establishing productivity, technical standardization, metrology, and quality control and certification centers, as well as institutions for assisting small and medium industry.

Establishing mechanisms that will cover the whole range of problems relating to the transfer of technology.

Studying the establishment of multinational Latin American enterprises that will generate, adapt, and market technology.

Establishment of active information systems that will include documentation centers and specialized services for selecting, analyzing, and disseminating information for small- and medium-sized industry and for the productive sectors.

Strengthening the institutional mechanisms for the formulation of science and technology policies duly integrated in overall development planning, and placing them at a high level in the government's political and administrative structure.

Establishment of mechanisms for compiling and evaluating information for scientific and technological policy.

TO THE AGENCIES OF THE INTER-AMERICAN SYSTEM:

To establish procedures for periodic adjustments in the activities financed by the Special Multilateral Fund for the Inter-American Council for Education, Science and Culture.

To study the establishment of a regional metrology and calibration system.

To orient the Pilot Project on Transfer of Technology in accordance with the recommendations of CACTAL.

To study the possibility of establishing a regional system of patent banks.

To cooperate in the acquisition and processing of library materials.

To make OAS information activities compatible with those of the United Nations Information Systems.

To study international legislation on regulation of technology transfer.

TO OTHER INTERNATIONAL AGENCIES:

The holding of specialized technical-practical symposia among representatives of various scientific and technological areas.

The coordination of activities related to the transfer of technology.

The study of international legislation on regulation of the transfer of technology.

To provide aid on the basis of national scientific and technological planning.

Maximum flexibility in the financing of scientific and technological activities, thereby giving rise to new methods such as program loans and triangular contributions.

TO THE DEVELOPED COUNTRIES:

To cooperate with the Latin American countries in order for them to improve their capability for acquiring, absorbing, and disseminating technology, for this purpose, to cooperate in the creation of international mechanisms to provide information on available technology and to furnish them with the necessary technical assistance.

To provide their enterprises with incentives to facilitate the dissemination of patented and nonpatented technical knowledge to the Latin American countries under nonrestrictive conditions and at low cost.

To encourage their enterprises and their branches or subsidiaries located in Latin America to use technology that will make the maximum use of the natural resources and the local manpower of the countries of the region so that they will continuously transmit to the country receiving the technology their knowledge on specifications, production methods, and techniques in general.

To support the countries of Latin America in the application and adaptation of the technology required for their productive structures and social needs, providing them cooperation in the fields of information, technical assistance, planning, business administration, and marketing, and also financial assistance under conditions that are compatible with their scientific and technological research programs and projects.

To foster the opening of multilateral consultations and negotiations among the Latin American countries intended to develop agreement on methods that will reduce costs and eliminate restrictive commercial practices in the international transfer of technology. □

[While everyone agreed to the Consensus of Brasilia as a whole, the U.S. Delegation was obliged to abstain on several specific points, as reflected in the official Final Report of the Conference.]

Declaration of Principles

I. The member states of the Organization of American States represented at CACTAL hereby reaffirm, as guiding principles for the work of the Conference and for the specific action arising therefrom, the economic and social standards as well as the standards on education, science, and culture contained in the Charter of the Organization.

II. The member states, inspired by the principles of inter-American solidarity and cooperation, and bearing in mind in particular Articles 29 to 50 of the Charter, reaffirm their determination to join efforts at ensuring social justice in the hemisphere and overall, dynamic, and balanced development for their peoples. They likewise ratify their pledge to mobilize their own national human and material resources as a fundamental condition for their economic and social progress.

III. The member states reaffirm, as an essential condition for the full exercise of national sovereignty, without impairment to regional cooperation, the need to strengthen their capacity to make their own decisions regarding creation and adoption of the science and technology required for the development of their peoples.

IV. The member states, in conformity with the provisions of Article 40 of the Charter, recognize that integration of the Latin American countries is one of the objectives of the inter-American system and, consequently, reaffirm that they will orient their efforts and adopt the necessary measures in the field of science and technology, in such a way as to contribute to the attainment of that objective in the shortest possible time.

V. The member states, with the aim of ensuring the well-being of their peoples, and pursuant to Article 36 of the Charter, agree to adopt concrete measures to extend among themselves the benefits of science and technology by encouraging the exchange and utilization of scientific and technical knowledge.

VI. The member states recognize that in Latin America the primary function of science and technology is to contribute to overall development and improve the quality of human life.

ANNEX 2.

2. Role of information in the processing of technological requirements

1) Demand identification and formulation

The Pilot Project on Transfer of Technology of the Organization of American States has demonstrated that the first difficulty arising from the transfer of technology to the developing countries is the accurate identification and formulation of the problem by the recipient. As a result of the low capacity to handle information and the incompleteness of the available information, the technological problem is very rarely explicitly formulated at the entrepreneurial level. Thus, demand in the productive sector remains rather implicit. Consequently, it seems helpful to develop a "technique" to formulate the demand, based on the dissemination of the first information susceptible to facilitate its definition, frequently attained by successive iteration.

The concept of "technological requirement" appears at a stage in which the problem is sufficiently identified so as to be formulated in operational terms allowing the initiation of the search for information.

The sequence between "necessity" and "demand", and between "demand" and "formulated demand" is ensured by means of mediation techniques. This results in an increasingly closer contact between the information centers and the users of their services, as well as in the user's access to a logistic base of information (primary information) and technical assistance.

2) Need of new products of information. TEC information

The neuralgic problem of information required by the tecnological development appears in the stage of feasibility (or prefeasibility) studies for the selection of the technological processes. This is especially true in the case of large projects involving the initiation or entry into new activities in the country or by the recipient enterprise. It is a strategic choice that subordinates all other activities and bears heavily on the future development of the project and its effects on the country's technological development.

From the informational point of view, the technical-economical evaluation of a given technology involves:

a) Availability of technical information on the processes, patented or not, as well as a knowledge of the physical characteristics of the performance and technical coefficients of the various technologies involved;

b) An appraisal of the number and qualifications of the required man-power and the influence the technologies under consideration may have on the tasks related to the maintenance of facilities and business management;

c) Knowledge of the cost of the different components and outputs, in order to be able to dissociate, for inputs and outputs, quantities and unit prices. This allows an estimate of cost-benefit on the

basis of the price structure of the country's means of production.

d) Knowledge of the existing links between the engineering firms which could cooperate in the project and the owners of the technological procedures and the required capital goods, as well as information on the conditions of their commercialization.

All this requires the creation of a type of technical-economic-commercial information, that is to say, an "elaborated" information.

Experience has shown that most available information is 1) scattered; 2) heterogeneous (depending on the sources); 3) unidimensional.

The "unidimensional" character of the available information is expressed in two forms:

a) "free" information is technical or economic, rarely technical-economic and never technical-economic-commercial.

b) The scarce free technical-economic information is, almost in every case, aggregated in global costs. This makes it difficult, or practically impossible, its desaggregation in primary information, order of aggregation included in it, quantities and unit and partial prices.

To conclude, it is necessary:

a) To have access to primary information and not unidimensionally globalized information with a reduced structural content.

b) To structure primary information according to the objectives and operational and decisional needs of each stage of the development process of a given productive unit.

Desaggregation of the technological process goes beyond the separation of technologies in "medular" and "peripheral", and reaches the stages of the production process itself.

Finally, information structured in this way constitutes a very important tool for the developing countries, and may partially compensate the "flaws" in the technology market.

Assistance to the developing countries, at an international level, should be devoted to the elaboration of this type of information.

To eliminate mimetic transfers implies not just the observation and comparison of existing solutions, but the establishment of new technical combinations non-existent at present.

Innovation does not necessarily require new knowledge, but the grouping of existing knowledge in new combinations. On the other hand, the associations of ideas and analogies stimulate the inventive process. Therefore, one of the main tasks of the information services is to provide "analogy images" to stimulate technological creation and innovation. This requires the intensification of studies on technological typologies and their relations with informative typologies.

ANNEX 3.

3. A Technological Management Program. Objectives and fields covered

1. Objectives

In order to contribute to solving the problems and to help meet the requirements indicated in the preceding section, the following objectives have been set for the program for strengtheining technological management:

i. To cooperate in the establishment of technological management as one of the most important functions of business management and administration by fostering, among other things, a clear understanding of its need by the business community; clarification among the enterprises of the relation between the technological management function and the other management and administration functions; establishment of an organizational structure within the business which will make possible an efficient technological management; and the establishment of operational methods suited to the performance of this function.

ii. To encourage the enterprises to consider the objectives of the national technological policy recognizing the coincidence between this policy and their own interests,or to indicate through suitable means the differences that may exist between national policy and business standards of profit.

iii. To foster the establishment in national agencies of advisory facilities in which business may seek advice with regard to the problems they face in performing the tasks of technological management, including

technological evaluation, formulation of strategies, organization of adaptation and innovation, promotion of technological creativity, etc.

Also to ensure that they will be able to find the support available in the local technological infrastructure and make efficient use of it in terms of services such as technical standards and quality control, technical data, patent examinations and others.

iv. To foster the strengthening of management in research and development agencies and technological services. This is aimed at a more efficient use of resources and reorientation of activities designed to promote an increased attention to the most important technological problems of national economic and social development. The latter requires a more active cooperation from those entities which provide services to the private and public agencies and participation in the development of projects of their own or of the enterprises, to help apply the achievements of science and technology to solve the above mentioned problems.

v. To develop in those agencies special lines of support to technological management of medium-and small-size enterprises, taking into account the limitations stemming from the lack of manpower and materials in those enterprises.

vi. To disseminate the application of methodologies suited to the management of technological projects and the adequate treatment of

technological aspects in all phases of the development of investment projects.

2. Fields Covered

The activities to be carried out under the program cover three main fields, as follows:

i. Technological business management;

ii. Management of agencies providing technological services, including research and development; and

iii. Technological project management.

There will be a certain degree of specialization in each of these areas. It is important to keep in mind the need for an overview of the relation between them as well as the interconnections between the program's objectives.

Therefore, research development and technological services of agencies should be managed in keeping with the requirements of the individual enterprises. This is only possible if, at the same time, a technological management capable of recognizing and making use of the local technological infrastructure is developed and if there is sufficient assurance that such management will encourage the application of innovations generated with the help of technological resources at the national level. Another important example is the interdependence of the objectives of project management and of the management of technological service agencies. It is vital that project management be consistent with the

national policy of increased use of the country's technological resources. This approach however, depends on the supply of technological services coming from the local infrastructure.

A program's comprehensive approach means that it considers technological management as a system in which the various factors of action are intertwined, supporting and strengthening each other. To this effect, it is desirable that the program's various activities be evaluated in the light of the general framework of all the principal problems relating to technological management which might require action in each country. Since the OAS member countries differ in their degree of development, their geography, economics, institutions, etc., each of them should consider its own framework of problems in order to evaluate the kinds of support the program can offer. At the same time, at the request of each country, the program can help analyze and evaluate the situation and the technological management requirements of each individual country. These analyses and evaluations should answer the following questions: Which of the program's three areas require attention in specific countries? Is it necessary to act in terms of the problems characteristic of each area taking them as a whole, or merely to resolve one or some critical problems? What is the most favorable sequence of action? In any event, the Program could support plans for the integral strengthening of technological management which would embrace all important aspects of any of the three areas, as well as more discreet actions aimed only at eliminating the most severe

weaknesses affecting one of the areas of such management. Detailed below are the most important aspects of technological management in which the program can provide support:

i. Industrial enterprises

- Design of the organizational structures required for a complete performance of the technological management functions in supervision and administration, with relation to the problems of sectors with different intensities in the use of technology and to the problems associated with the size of the enterprise.
- Technological evaluation; technological profiles of enterprises and production areas.
- Technological strategy and planning for enterprises.
- Adaptation, innovation and creation.
- Selection, negotiation, and acquisition of technologies.
- Management of technical standardization and quality control.
- Organization and administration of technological capacity and of technological management training.

ii. Institutions for research and development and technological support services

- Establishment and development of channels of communications with the production sectors in order to ensure ample knowledge of their technological requirements.

- Development of training and advisory services aimed at business men and executive and technical personnel in order to direct their interests toward new applications of technology to their products and processes and toward their possibilities of support from the local technological service agencies; and, in general, their orientation toward well-conceived and implemented technological management.
- Planning of their own activities, with special attention to those aimed at service to the productive sectors.
- Establishment of suitable operational methods for cooperation with enterprises in the formulation and implementation of technological development projects and for the provision of sciences for the technological management of new investment projects.
- Development of the appropriate organization necessary to implement activities aimed at serving productive enterprises. For this purpose, the establishment and strengthening of departments or units specialized in assisting the development of processes and products and in troubleshooting activities.

  This organization should consider the special supervision and programming problems which emerge from the reorientation of activities toward the problems of national production as well as the necessary changes with regard to project evaluation and

and control, financial management, relations with other institutions, promotion between enterprises and public relations, information and diffusion, etc.

Training of appropriate personnel for project management and for assistance to enterprises in programs aimed at strengthening their technological management.

- Promotion of regional sectorial networks of institutions in order to make the best use of their abilities and experience.
- Coordination of activities of national sectorial networks to better meet the requirements of the enterprises and sectors of enterprises.

iii. Projects:

- Identification and generation of new technological projects; preparation and analysis of technological profiles as instruments for identification and generation of projects for technological improvement, adaptation, innovation and creation.
- Establishment of technological standards that may be used in the preparation of feasibility studies.
- Opening of the technological package in preliminary projects and investment projects.
- Organization of the use of local consultants and engineers in the preparation of feasibility studies, preliminary projects and investment projects.

- Organization of channels of communication between those responsible for technological management applied to the process of project formulation and implementation on the one hand, and national capacity for the design and manufacture of capital goods on the other hand.
- Training for technological project management.